

Technology Review

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\$3.00

The Overworked American

*Why higher productivity
hasn't given us more
leisure time
(and what to do
about it)*

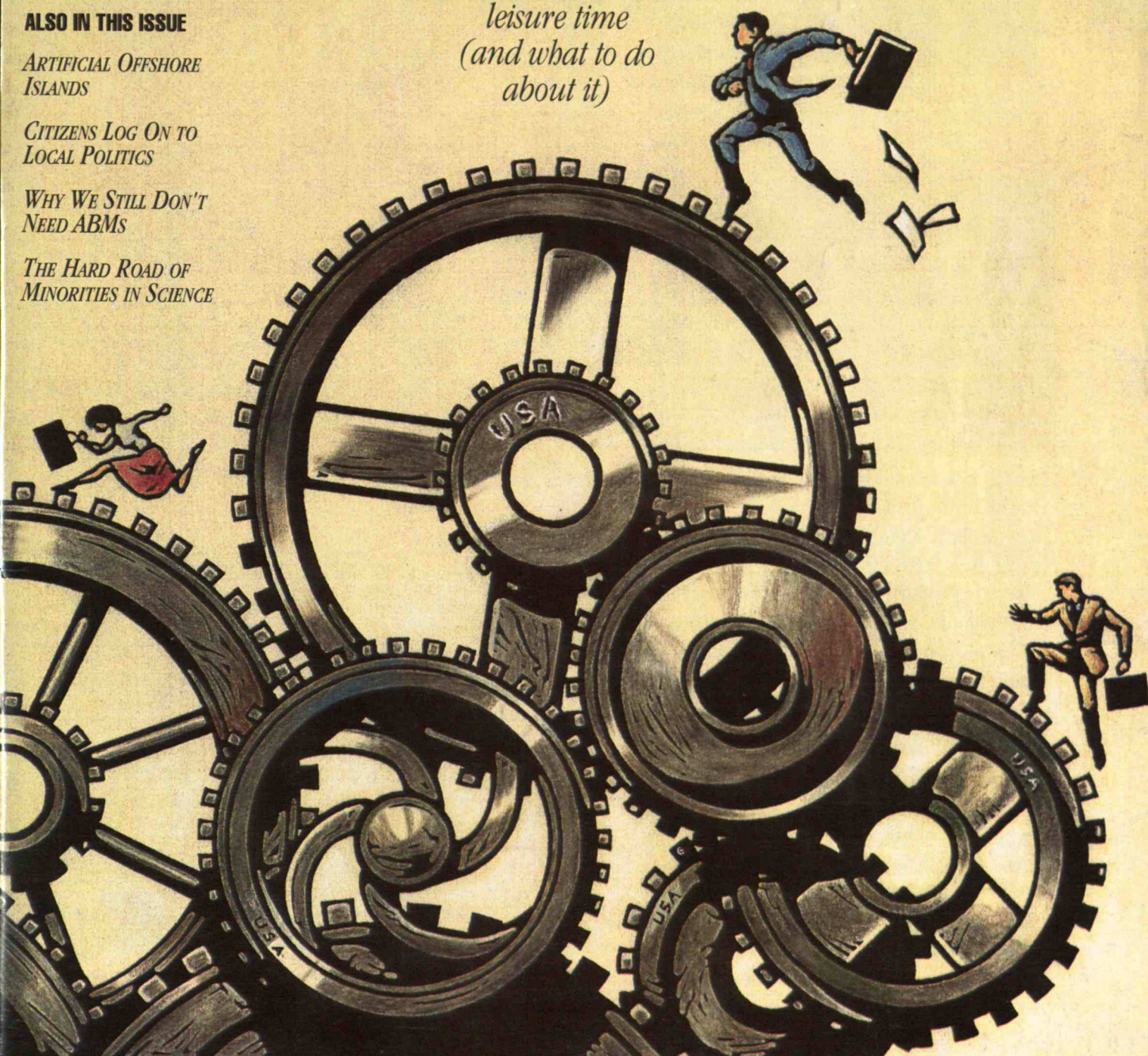
ALSO IN THIS ISSUE

ARTIFICIAL OFFSHORE
ISLANDS

CITIZENS LOG ON TO
LOCAL POLITICS

WHY WE STILL DON'T
NEED ABMs

THE HARD ROAD OF
MINORITIES IN SCIENCE



technology review

Published by MIT

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Attila t



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Illustration: Bruce Maddocks

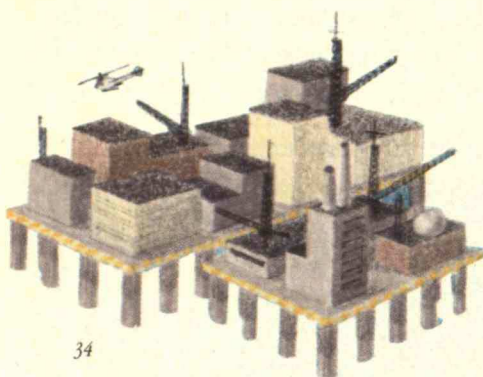
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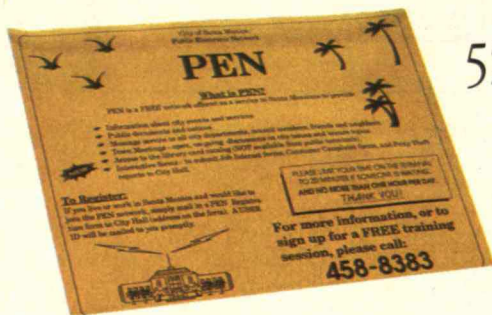
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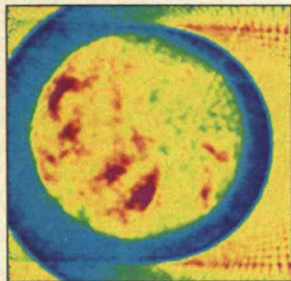
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If it had less legroom, a lesser warranty, and cost thousands more, it could be a Cadillac.

Logic would seem to dictate that when you pay thousands of dollars more for a car, you should get a lot more car. Apparently, in the case of the Cadillac Sedan DeVille versus the Chrysler Fifth Avenue, logic does not apply. Both cars provide ample room for six, air-conditioning, automatic transmission, automatic load leveling, stereo



sound system, fully reclining seats, all as standard equipment. Both offer safety and performance. A driver's air bag is standard on the Chrysler Fifth Avenue, as is a powerful fuel-



injected, 3.3-liter V-6. Anti-lock brakes are also available. Here, however, is where logic totally falls apart. The restyled Chrysler Fifth Avenue costs thousands less, yet it has more rear legroom than the largest Cadillac*. And it offers a better warranty: bumper-to-bumper

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First Line

A Splash of Cold Water

A French industry scientist was recently telling me how European companies acquire prestige and commercial advantage by supporting research at U.S. universities. "And at our firm," she added, "we especially like to support meat!"

"Meat?" I asked, not certain whether my ears, after a week of trying to process French, were a bit worn out or whether this administrator knew American slang and was referring to substance.

"Yes," she said, "we fund projects at 'meat'—you know, MIT—and other leading academic institutions in your country."

Despite the universities' well-earned reputations, people at home and abroad may lately have started wondering just how meaty they may now be. Researchers in the ivory tower—once regarded as saintly, thrifty to a fault with the public dollar, and, most awesome of all, steeped in nature's secrets and skilled in tapping them for humanity's benefit—have lately come down to earth.

University scientists work with companies seeking to commercially apply (that is, derive financial gain from) their academic research. Hardly the exploitable absent-minded-professor type, they often help found the companies themselves. Whole universities, once deemed oblivious, even disdainful, of the profit motive, now wheel and deal with the best of them. Meanwhile, academic researchers demand more money than ever from public coffers, predicting widespread disaffection in the R&D community and eventual economic calamity for the nation should they not receive it.

Add to the newly mercenary perception of academia a straight-out series of black eyes—misuse of federal funds (university yachts and presidents' home furnishings charged to the taxpayer), allegations of price fixing in awarding scholarships, and cases of misjudgment, fraud, and plagiarism—and it's safe to say the public has been rudely awak-

ened. Researchers turn out to be just plain folks. Like everyone else, they look out for themselves, they sometimes make mistakes, and they bruise when they fall.

With the meaty image now seemingly tarnished, people may well ask "Where's the beef?" No longer regarded as demigods, some academics worry that funds will dry up if disappointed and overreacting patrons begin to question the value of the present research enterprise altogether.

But it may well be the researchers themselves who are overreacting in their

*The recently
sullied image of academic
research could, ironically,
help make scientists
more effective
than ever.*

assessment of the damage. Scientists' remarkable record of achievement has made research universities a unique resource, and the American people know they can expect that quarter to continue improving their lives and their country's standing. Yet as the world changes, so too must the relationships between researchers and those who support their work. And the greatest attitudinal change must be in how the research community regards the public, not vice versa.

When I was an engineering graduate student in the late 1960s, colleagues would joke about how research proposals inevitably boasted that the work would use a "high-speed electronic digital computer." Such terminology—forbidding to outsiders at the time—was often meant to wow potential funders. It was a reminder that a great divide existed between them and us and that close scrutiny would be practically impossible. Nonresearchers, it was assumed, were simply too ignorant to

understand our methods, much less make useful suggestions.

But along with the public's growing sophistication in matters scientific and technological—ordinary people now routinely use high-tech tools far more powerful than the machines we invoked for smokescreen value—has come the realization that researchers' work not only is understandable to, but is the business of, everyone else. This doesn't diminish the value of the academic enterprise; it simply means that R&D is a human endeavor like any other and that its practitioners should not expect to be exempt from the usual rules.

Thus the deflation of the superhuman academic scientist is actually a good thing and long overdue. Why, after all, should the desire to make money, or the capacity to make mistakes, be so shocking? Researchers *should* seek to apply their work to the benefit of their institution, their country, and themselves. Such strivings are a basic human trait. So, too, of course, are frailties and excesses, though ways of minimizing their adverse effects can also be evolved—as long as the environment is one of tolerance and mutual respect. Having discovered our partners' shortcomings doesn't mean we should quit working with them; on the contrary, it lets us collaborate more effectively.

In that spirit, even the recent lapses and scandals can be regarded as potentially beneficial to the long-term health of the research enterprise. They underscore the need for public accountability, public communication, and even public oversight, which should not be viewed as intrusions but as opportunities for interacting more fruitfully with the rest of the world. Instead of regarding the recent affronts to the academic image as a signal to defensively circle the wagons, researchers should see them as little more than a wake-up call. The appropriate response may be, like that of the guy who got slapped with after-shave in the television commercial, "Thanks, I needed that!"

STEVEN J. MARCUS

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Letters

AUTONOMOUS WEAPONS

In an otherwise well-informed article ("Behind Desert Storm: The New Military Paradigm," TR May/June 1991), Michael Klare succumbs to a common misconception. Specifically, he states that some of the weapons used in the gulf conflict employed "sensors and microcomputers to locate, track, and strike targets."

In fact, "autonomous" location and tracking, as it is known to weapon designers, is an extremely demanding problem that has not been solved. Of the weapons Klare discusses, only the troubled Tacit Rainbow anti-radar drone, which probably will never be deployed, is designed for such a mission. And if it can complete that mission, it will be only because targets cooperate by emitting their distinctive signals. The Tomahawk, Paveway, SLAM, and HARM missiles also mentioned in the article rely on human beings—either mission planners or pilots—to pick out targets and assign weapons to them. Interestingly, fewer than 83 targets were found in all of Iraq and Kuwait for the Tomahawk, which can be thought of as an ancestor of future autonomous missiles because of its long range.

The misguided notion that the age of autonomous weapons is at hand is important to correct for at least three reasons. First, it may foster overconfidence in political leaders and the public that mid-intensity conflicts can be "discriminate" or "surgical." Second, it helps promoters of new systems to secure funding from members of Congress who are not always able to distinguish legitimate descriptions of a system's capabilities from spurious claims. Discredited cruise missile designs are already being dusted off in hopes that they might benefit from the postwar wave of enthusiasm for the Tomahawk.

And third, implicit in the belief that cruise missiles can find and attack camouflaged targets on their own is the argument that the B-2 bomber—which would carry better sensors, more electronics, and two human brains—can succeed in its primary mission of search-

ing for and destroying mobile strategic missiles. This conclusion, though false, might have serious implications for federal spending priorities if widely accepted.

ERIC H. ARNETT
American Association for the
Advancement of Science
Washington, D.C.

REGULATION IN BIOTECH

Thank you for your fine and well-balanced article on bovine growth hormone ("Who Decides About Biotech?" by Wade Roush, TR July 1991). Thanks, too, for your sympathetic treatment of citizen input in scientific debates. Those who question the value or relevance of such input often assume that "the market" and existing regulatory agencies will protect us. Or they feel that even if citizen input were appropriate, our scientifically illiterate populace could scarcely be trusted to make sound judgments. Both of these assessments are misguided.

The framework for regulating genetically engineered organisms patches together several existing mechanisms, and the problem with this is that the challenges of biotechnology are unprecedented. As many regulators will themselves admit, biotechnologies tend to fall through the cracks of definitions that were developed for other purposes.

Even more worrisome, the Bush administration has attempted to block development of a regulatory apparatus that would deal specifically with environmental releases of genetically engineered organisms. The administration has stated that before oversight can be exercised, an organism must be proven to pose significant risks. Without this proof, oversight is actually prohibited. In other words, we must prove that something is harmful before we may study whether it is harmful.

Regarding the value of the market in weeding out bad products and encouraging useful ones, true consumer choice rests on adequate information, and a great deal of information about

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LETTERS

most biotechnologies simply does not exist yet. As long as it does not, the choices that prevail in the market will not be informed choices, and thus may not reflect underlying consumer preferences. Furthermore, if industry has its way, the labels of genetically engineered products won't even provide what information does exist.

It's also worth noting that many of the products consumers would like will never be available because they offer inadequate opportunity for profit. For example, farmers would like high-quality non-hybrid seed so that they could harvest their own seed and use it the next year. But seed companies do not find this attractive, since it would cut into their market, so they have focused on developing hybrid seeds that must be purchased every year.

Finally, it is unfortunately true that many of us are scientifically illiterate. However, an extensive study by the Public Agenda Foundation shows that there is cause for hope. This study assembled a series of citizen review panels, gave them a pre-test questionnaire about a problem, and then showed them a 15-minute video that presented a variety of possible solutions and explained the points of agreement and disagreement among experts. Afterward, participants in the study discussed the problem in groups and filled out post-test questionnaires.

Interestingly, the conclusions of the participants generally agreed with those of leading scientists. And in many cases where they disagreed, the reason was not a lack of scientific understanding. Rather, the citizens used different criteria in making their policy decisions—such as distrust of government and industry or a desire to avoid paying more taxes. In short, ordinary citizens, given balanced information and an honest view of disagreements among scientists, can make reasonable decisions—scientific and non-scientific.

KATHERINE GRIFFITH
Biotechnology Project Coordinator
Wisconsin Rural Development Center
Mount Horeb, Wis.

Editor's note: An article on the Public Agenda Foundation's study is scheduled to appear in the next issue of Technology Review.

SANITIZED WAR

In "Engineers and the Nintendo War" (TR July 1991), Samuel Florman claims that Operation Desert Storm demonstrated "a heightened concern for individual human lives."

He describes an "unprecedented effort to minimize casualties—at least among the allies—but also a studied determination to avoid discussing them." It is unfathomable to me how Florman can view these actions as evidence of "an amazing step forward on the road to civilization." Quite the opposite is the case.

The silence on casualties and the sanitized views of Nintendo-like destruction have made it easier for us to forget that there were real people being injured and killed. Many credible accounts suggest that over 100,000 Iraqi troops were killed in the war. That this slaughter was barely mentioned in the media amidst the heroic chest-thumping shows how little value we place on human lives.

JOEL WEISBERG
Eagan, Minn.

CORRECTION

In "The Invention That Got Away" by Richard Florida and David Browdy (TR August/September 1991), former MIT president Jerome Wiesner was incorrectly cited as the chair of an advisory board for the Boston investment firm approached by T. Peter Brody to fund development of active-matrix displays. Jerome Wiesner was instead one of several informal advisers to the group as well as an individual investor in Brody's work.

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OYSTERS IS NOT RESTRICTED TO THE
DINING ROOM TABLE ...

There will always be a
CHIVAS REGAL.



MIT Reporter

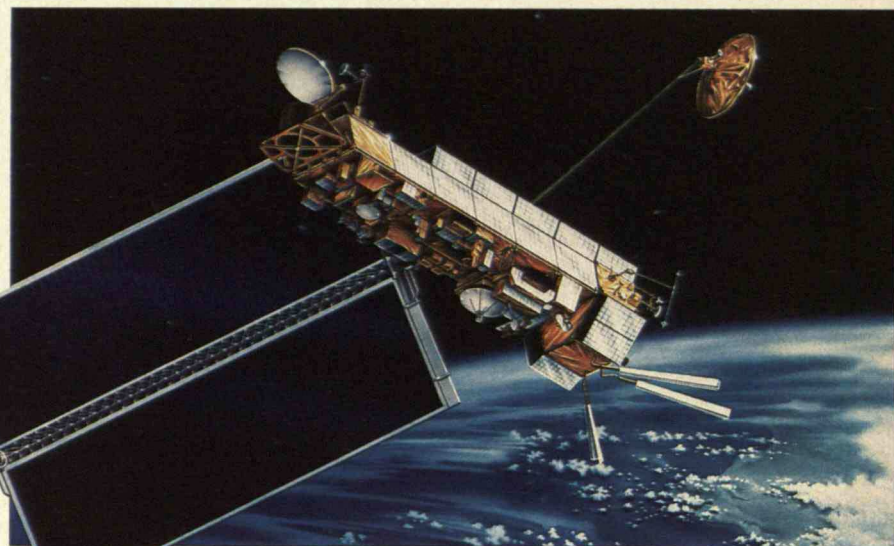
GETTING HEATED UP OVER CLIMATE RESEARCH



If there is a single point on which all parties to the debate on global climate change agree, it is the need for more research. But how should the government set its priorities? Not as it has done so far, says MIT oceanographer Carl Wunsch. He contends that the billion-dollar budget of the U.S. Global Change Research Program (USGCRP) is largely misdirected.

In 1989 a presidential initiative established the USGCRP to coordinate—on paper, at least—what various federal agencies were spending on global change research. The committee developed a priority framework for research that the National Academy of Sciences reviewed and endorsed. The problem, says Wunsch, is that the USGCRP does not have the power to decide how money will be spent. Instead, Congress decides on the size of the budget for each federal agency.

NASA has so far secured the lion's share of global change research funding—\$770 million of the \$1.2 billion USGCRP budget proposed for fiscal year 1992. The centerpiece of NASA's efforts is the Earth Observing System (EOS). This ambitious multi-satellite network is supposed to track the planet's climatic and environmental change by conducting comprehensive monitoring of vital signs such as moisture, temperature, and cloud formation. EOS



could cost more than \$30 billion by the time it is completed, although NASA officials have recently announced that they are considering alternatives as well.

Wunsch questions the value of putting the bulk of the current global change funds into EOS. "The government's priorities," he says, "are to put most of the resources into a system that will not produce any data for 15 years. Does this really make scientific sense?"

But John Theon, NASA's chief of atmospheric dynamics and radiation science, says that the "enormously complex project" would require full funding to get under way. "Though space hardware looks terribly expensive, there is no other way to get comprehensive global coverage," he maintains.

Meanwhile, however, other research projects go begging. Wunsch points to his area of oceanography as a prime example. The World Ocean Circulation Experiment (WOCE), which started in

NASA's Earth Observing System has secured much of the money allocated for federally funded research on global change. Among the satellites planned for the project is a polar orbiting platform.

1990, is measuring circulation patterns at all depths. Global warming could affect ocean circulation, which could in turn trigger further global temperature change. Evidence already exists of changing circulation patterns in the deep ocean, but today's circulation and feedback models are crude. While the USGCRP considers WOCE "important," Wunsch says that the project is "being starved for funds. The U.S. program is close to two years behind schedule, and we've reneged on international commitments" to fund 40 percent of the overall budget. Other countries are not taking up the slack, he adds.

In a report last year on research strategies for the USGCRP, the National Research Council, an arm of the National Academy of Sciences, warned that federal funding for WOCE is inadequate. The council went on to assert that "such a system must be put into place if we are to describe, understand, and ultimately predict global change." The United States allocated \$15 million



MIT oceanographer Carl Wunsch suggests that some global change research projects, such as the World Ocean Circulation Experiment (WOCE), deserve more funding. As part of WOCE, researchers deploy instruments that monitor currents.

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for the program this year. "In 1993," says Wunsch, "we project we will need \$50 million, but expect to receive only half that amount."

The National Research Council report also pointed out that some other programs, such as efforts to study the extent to which soils may serve as carbon sinks, were also poorly supported.

Wunsch's concerns over funding balance are shared by John Eddy, director of interdisciplinary earth studies at the University Corporation for Atmospheric Research in Boulder, Colo. While Eddy believes that studies using space-based observation tools are essential, he worries about NASA's domination of the USGCRP program. Space agency programs have seemed particularly vulnerable to political whims recently, he says.

Current U.S. research on global

change, in Wunsch's words, is "enormously fragmented" and in conflict with a caution in the NRC report: "There is no better example of the need for scientists and decision makers to work together than the broad range of issues concerning global environment change."—DAVID BJERKLIE (*The author is a science reporter for Time magazine.*)

SPRAYING STEEL



Bakers flatten pie dough with rolling pins; steelmakers use series of giant rollers to produce steel sheets that get turned into everything from car fenders to refrigerators. The process is costly, as is what precedes it: melting, molding, cooling, cutting, and reheating the metal. To lower costs and help the weakened U.S. steel industry compete, experts are trying to develop a simpler method—spraying

molten steel to the desired thickness.

Spray deposition, as the technique is called, requires forcing liquid steel through a ceramic nozzle, explains Nicholas Grant, an MIT emeritus professor of materials science and engineering who is working on the idea. The nozzle sprays the metal onto a belt, applying it close to the desired thickness. The steel then requires at most 2 rollings, rather than the 10 needed by conventional sheet-steel production. The rolling ensures that the metal is uniformly dense and thick.

Sprayed steel is of higher quality than the steel made by the "continuous-casting" process used today, Grant explains. That's because when steel is sprayed in droplets that are less than 250 millionths of a meter across, it cools thousands of times more quickly. The rapid solidification prevents the growth of big crystals, which make the metal brittle and hard.

Research on large-scale production of sprayed steel originated in 1986, when Congress set up the Steel Initiative program to "leapfrog technology for the steel industry," according to Peter Salmon-Cox, director of the Department of Energy (DOE) Office of Industrial Processes. Apparently, other countries have not been working on large-scale spray deposition, which has become possible only in recent years with the development of purified ceramics that can withstand molten-steel temperatures of about 3,000° F. DOE is supporting spray-steel efforts by three groups—at MIT, Idaho National Engineering Laboratory, and Oak Ridge National Laboratory.

In 1989, the energy agency and nine companies gave the researchers 3 years and about \$5.5 million to conduct lab tests. Grant started testing his nozzle, in which gravity feeds liquid steel into a tube and a stream of gas then forces the liquid into droplets. The Idaho group focused on

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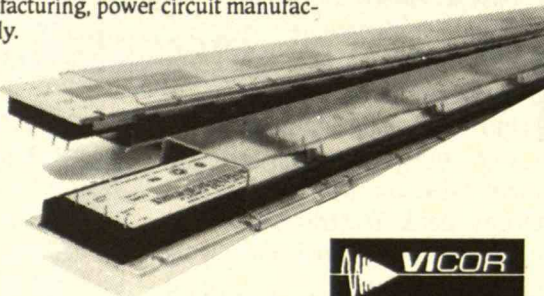
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PEERING THROUGH METAL

 In the comics, Superman's x-ray vision lets him see through steel. In real life, though, x-rays can't readily penetrate metal, and that limits their value for certain types of industrial testing: checking for internal flaws in aircraft structures, for example, or monitoring the integrity of metal-based composites.

Producing images with neutrons offers a solution, says Richard Lanza, a principal research scientist in MIT's Nuclear Engineering Department. Lanza, who has designed a neutron-imaging system with Eric McFarland—now at the University of California at Santa Barbara and formerly the Edgerton Assistant Professor of Nuclear Engineering at MIT—says that unlike x-rays, neutrons go right through many heavy elements. Such elements' nuclei, because of their energy configurations, present a relatively small target to the oncoming neutrons. By contrast, a nucleus of an element like hydrogen makes for a large target, rendering it largely opaque to neutrons.

A few users have tried neutron versions of standard x-ray systems, in which radiation is beamed through a target toward a sheet of film or some other light detector. An Air Force base in California is employing the approach to check fighter plane wings, and manufacturers of nuclear reactors have tried it in tests of fuel rods.

Like several other researchers, Lanza and McFarland have sought to improve the clarity of images by developing a neutron version of the computerized tomography (CT) scanner used in medicine. Such a scanner beams radiation at a target from several angles, then integrates the resulting signals into one image. Neutron-based CT scanners also help to solve the problem of the neutron particles' tendency to scatter when passing through a target. The computer

rules that govern the image's construction dictate that the system will not "see" as many signals from scattered neutrons as from those that have stayed on course.

Lanza and McFarland have used their system to produce images of water in an aluminum cylinder, silicone packings in a brass valve, and fluids in rock. The results suggest the kinds of targets that are suited to neutron imaging: corrosion in metal products; lubricants and seals in metal pipes and fittings; and

out that neutron tomography can provide "information you can't get any other way." The best sources are nuclear reactors—Lanza and Farland use MIT's experimental reactor—but their cost, size, and immobility (as well as public concerns about their safety) make them unsuitable for most industrial uses.

An option Lanza and McFarland are exploring to solve the source problem for small targets, such as the valve-encased silicone packings imaged in their experiments, is the accelerator-based neutron generator. This device works by accelerating subatomic particles toward a plate that bears a substance containing a significant number of neutrons. The interaction between the particles and the substance yields free neutrons that can be directed toward the target.

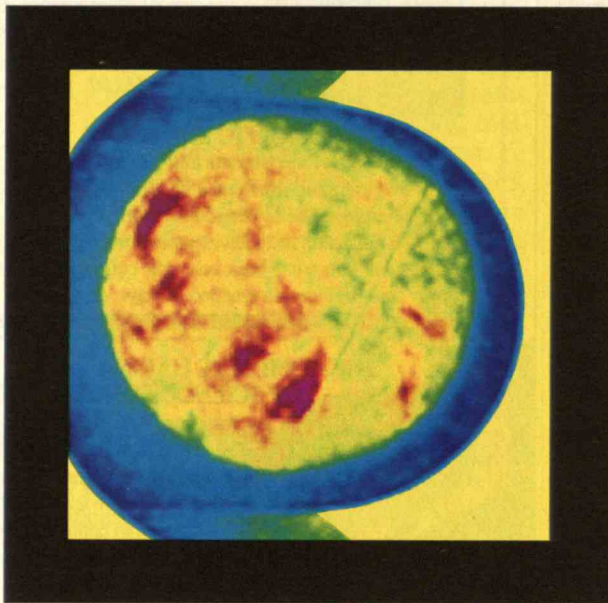
An instrument called a pulsed plasma fusion source may help in imaging larger targets. This device, roughly the size of a small picnic cooler, generates huge jolts of electricity that in turn result in plasmas, or gases whose particles bear electrical charges. With each burst, the plasma's high temperatures generate small reactions that can yield up to a trillion neutrons. The electric

currents are so great, however, that the switches would rapidly wear out if used on a routine basis. Investigators at NASA and elsewhere are developing tougher switches.

McFarland and Lanza are trying to adapt both types of sources for use in neutron tomography.

Even if they succeed, there is still a cost problem. Lanza estimates that a neutron scanner incorporating a pulsed plasma focus source could cost up to \$500,000. He argues, though, that this ought not to deter some users. "We're talking about looking at products such as aircraft wings, where the incremental cost of failure is very, very high."

—RICHARD ANTHONY



oil in samples of rock, which often contain elements that x-rays cannot penetrate.

Designing a system that works in the lab, though, is not enough. The lack of practical neutron sources has kept neutron imaging from broad acceptance, says Edgar Rhodes, a physicist at Argonne National Laboratory, pointing

A system designed at MIT can examine rock samples for holes and fissures through which oil can flow. In this image, such openings appear red.

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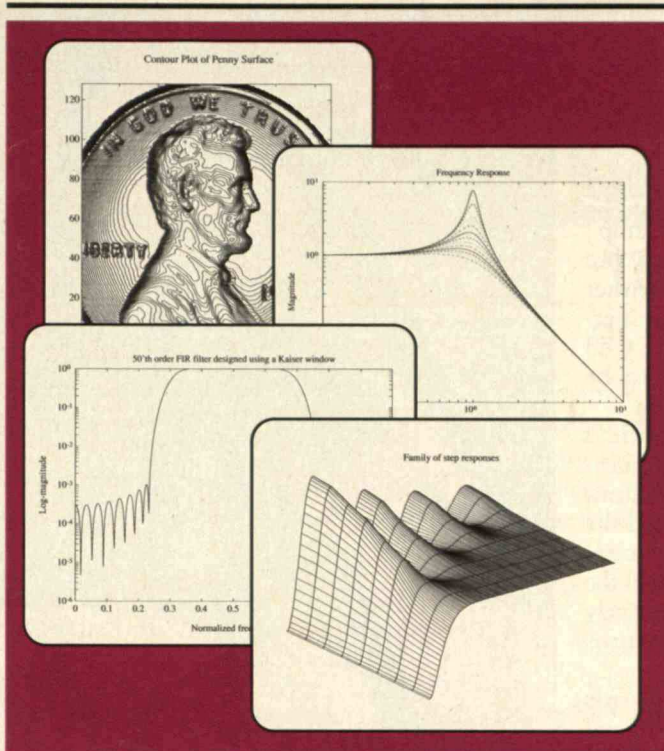
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Trends

Learning to Be Wilder

It's called "boot camp" or "headstarting," but the participants are neither marine recruits nor inner-city children. They are wild animals that have to be taught how to be wilder.

The reason is a radical change in zoos and aquariums. Pushed by restrictions on animal exports and the threat of extinctions, exhibiting institutions in the last two decades have largely ceased buying creatures caught in the wild.

The first result of this change was zoo-based breeding; 93 percent of mammals and 71 percent of birds in major zoos are now bred in captivity. In particular, 56 rare or endangered species are enrolled in cross-institution breeding programs based in zoos and aquariums.

Stemming from these efforts is a logical next step. Zoos have become arks for endangered species, seeking to return animals to the wild.

That's easier said than done. While captive breeding has regularly succeeded, releasing endangered animals often proves exasperating. Researchers at the U.S. Department of Fisheries and Natural Resources recently analyzed 405 efforts to reintroduce animals into wild habitats in North America, New Zealand, and Australia. More than 60 percent of the captive-bred stock perished. Conversely, nearly three-quarters of wild animals that were trapped and re-released where they once roamed reestablished their species.

"There is a tendency to coddle animals" in zoos, notes Scott Derrickson, curator of ornithology at the National Zoological Park's Conservation and



To prevent this six-day-old condor from bonding with a human keeper, a handler feeds it using a puppet shaped like an adult condor head.

Research Center in Front Royal, Va. The animals may lose the savagery they need in the wild.

To combat coddling, various zoos have tried to rear animals in a way that not only preserves but enhances wildness. "It's not teaching an old dog new tricks, but teaching animals to do [their tricks] more effectively or efficiently," says research zoologist Bryan Miller of the National Zoo.

One of the most refined headstarting projects is the San Diego Zoo's efforts to give captive California condors the illu-

sion that they are being reared by their natural parents. The zoo's animal behaviorists fear the birds could "imprint"—emotionally bond—with a human keeper. Condors might associate people with food and later stray too close to inhabited areas.

To guard against this, zoo staff manipulate the condors in dark booths or blinds. Handlers don hand puppets shaped like condor heads when preening, feeding, or cleaning up around the young birds. And they refrain from talking near nests so that condors won't associate speech with food.

Apparently successful releases of a surrogate species—zoo-bred Andean condors—suggest that, for this species at least, the hands-off approach may ensure wildness. However, precisely the opposite occurs with sea otters, illustrating how difficult repopulation actually is.

At first, the Monterey Bay Aquarium in California

released zoo-raised otter orphans based on the supposition that human contact produces dangerous imprinting. But the first otter to go didn't know where to look for food and was returned to Monterey after almost starving to death.

So the aquarium has reversed its strategy and actively tries to bond otters with humans. Otters and wetsuited humans swim together, and the human foster parents show the otters—often for hours at a time—how to dive down, turn over rocks, and take the crabs that constitute an important part of otter diets. The humans also show the otters how to use rocks to smash the food open. The surrogate parents even teach the otters to wrap themselves in kelp to make a sea-going bed.

So far, three otters headstarted this

way are surviving in the wild. Once returned to the ocean, they appear to quickly break their bonds with humans.

A New Science

One program whose efficacy has yet to be established simulates a natural environment. After distemper threatened to wipe out the few remaining black-footed ferrets, the remaining members of this species were taken into captivity and entered into a breeding project. As with the condor, scientists are testing a head-starting program on the ferret's plentiful first cousin—in this case, the Siberian polecat.

In a mock village of prairie dogs, a standard food of ferrets, scientists at Front Royal are trying to boost the animals' wariness. To train the polecats to react quickly to potential predators, National Zoo researchers created "robo-badger"—a remote-controlled stuffed badger that they run through the village. At the same time, the keepers fire rubber bands at the zoo-bred creatures to teach them to associate badgers with danger. Similarly, stuffed owls hooked to overhead wires "fly" over the polecats. And to simulate the possible predatory effect of coyotes, one scientist has his pet dog roam the village.

Despite these efforts, trial releases of the polecat surrogates have been disastrous. All the animals have died within weeks of being freed.

National Zoo scientists are now trying a variety of ways to improve the technique. But because zoos are so unsure how to hone an animal's skills, some programs are pushing headstarting into the field with "soft releases." The idea is to provide animals with food, cages or shelters, and perhaps active preservation techniques as well to help them gain a foothold in a hostile world.

In perhaps the most famous such pro-

ject, golden lion tamarin monkeys have been reintroduced into Brazil with regular human guards. Initially, the monkeys also got partially peeled bananas, and strays were shepherded back to safety when they ventured too far from their troop.

However, fish and game workers in Alberta, Canada, have found that soft releases for swift foxes attract predators that kill most of the freed animals. Thus, a countervailing conservation strategy called "hard release" is drawing interest. The logic here is that nature eventually culls the weak from the strong, so humans should let nature take its course to ensure that the fittest survive.

Soft releases and hard releases each have adherents, but the truth is that nobody is yet sure what works and when. "You get lucky sometimes," says Nathan Flesness, executive director of the International Species Information System, which monitors what animals are where in the world's zoos. Turning that luck into a science is one of the new roles for zoos. —STEPHEN STRAUSS (*The author is a science writer for the Toronto Globe and Mail.*)



Taking a different approach, wet-suited humans swim along with zoo-raised otter orphans to teach them skills needed to survive in the ocean.



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Peddling Arms in Paris

■ Pilots, tank commanders, and other U.S. warriors who fought in the Persian Gulf acquired a new assignment this past June—hawking for the defense industry.

At its own expense, the Pentagon flew these men and women, along with a large selection of its military hardware, to the biennial Paris Air Show, arguably the world's premier arms bazaar. Systems as exotic as the F-117A stealth fighter and as pedestrian as Jeeps were stationed at the USA National Pavilion at the air show.

Much of the equipment had been recently used in the Persian Gulf, and the objective was to draw crowds to the exhibits of defense contractors, says the Commerce Department's David Bowie, who organized the pavilion. "By showing U.S. aircraft that performed superbly in the war, we were telling those visiting the pavilion that if you want excellent aerospace technology, you should look to the United States."

But the soldiers, flyers, and support crews that the Pentagon stationed at the pavilion were perhaps the more valuable part of the government's pitch. "They weren't out there selling equipment," says Joel Johnson, vice-president of the Aerospace Industries Association (AIA), a trade association of defense firms. "That's industry's job. But there's no greater salesman than a guy who flew the product, lived to tell about it, and liked it."

The Pentagon presence in Paris is the latest sign of the changing relations between the U.S. government and military contractors. The Bush administration, like Reagan's before it, is gradually reversing an anti-arms-sale legacy left by former president Jimmy Carter. In 1977, the Carter administration specifically told U.S. embassy officials overseas not to promote arms sales by U.S. industry.

Reagan reversed the ban soon after his inauguration, and Bush, too, has instructed officials to aid U.S. arms exporters. "There is an emerging recognition that sales of defense equipment is the currency of foreign policy, particularly with developing nations and with

nations that are modernizing their defense forces," says a lobbyist for a major defense contractor, who declined to be identified.

To be sure, the 1991 Paris show is not the first at which U.S. military technology has been exhibited. But in the past, a contractor wanting to display Pentagon hardware had to lease it from the government, insure it, fly it to the exhibition, and provide all the crews and support staff. Under a policy that went into effect for Paris, the Pentagon bore most of the cost. Firms just provided a display area, which they leased from the French government.

Not a Used-Car Lot

Not everyone is at ease with the new policy. To some in Congress, encouraging foreign arms sales is wrong-headed. "We cannot allow the global overcapacity in the defense sector, created by the end of the Cold War, to spur an ever larger trade in advanced weaponry," says Sen. Jeff Bingaman (D-N.Mex.).

In addition, says Sen. Claiborne Pell (D-R.I.), who chairs the Senate Foreign Relations Committee, "In the future, unless real controls are applied, our troops may have to face forces equipped with U.S.-made weapons."

In fact, while the air show was under way, the congressional Office of Technology Assessment unveiled a 179-page report that documents the country's status as the principal Western arms exporter. In 1988, the United States exported \$14.3 billion worth of arms, while NATO's European nations collectively exported just \$4.1 billion worth. Only the Soviet Union topped the United States in arms sales.

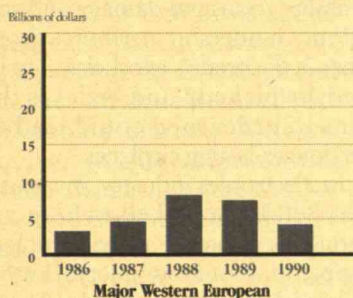
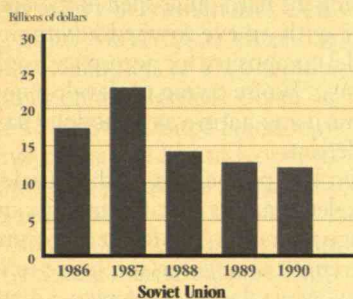
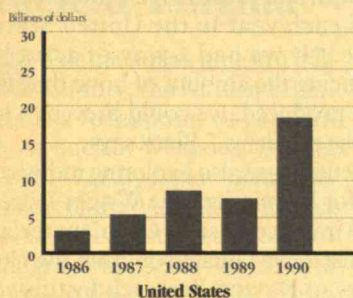
"This situation poses a major

The 1991 Paris Air Show signaled growing cooperation between the Pentagon and U.S. firms selling arms abroad.



Seashells are strong and light but not brittle. Materials scientists would like to duplicate those properties.

ARMS TRANSFER AGREEMENTS WITH THE THIRD WORLD, 1986-1990



national policy dilemma—how to balance the use of arms exports as instruments of foreign policy, pressure by companies for greater access to foreign markets, the need to stem a dangerous worldwide arms buildup, and the increasing proliferation of both defense equipment and [the] defense industry,” OTA warns.

A second congressional report, issued shortly after the Paris exhibition, made the preeminent U.S. role as global arms merchant even clearer. In 1990, the United States signed arms transfer agreements with Third World nations worth a record \$18.5 billion, according to the

Congressional Research Service. That was more than double the value of U.S. arms agreements in 1989 and over 44 percent of all global arms transfers to the Third World.

The “extraordinary increase” in U.S. arms agreements was due only in part to the invasion of Kuwait. The United States and Saudi Arabia had agreed on \$6.1 billion worth of arms transfers before the invasion. In fact, the study found, the value of U.S. arms transfers to Saudi Arabia outstripped the value of Soviet arms transfers to the entire Third World in 1990.

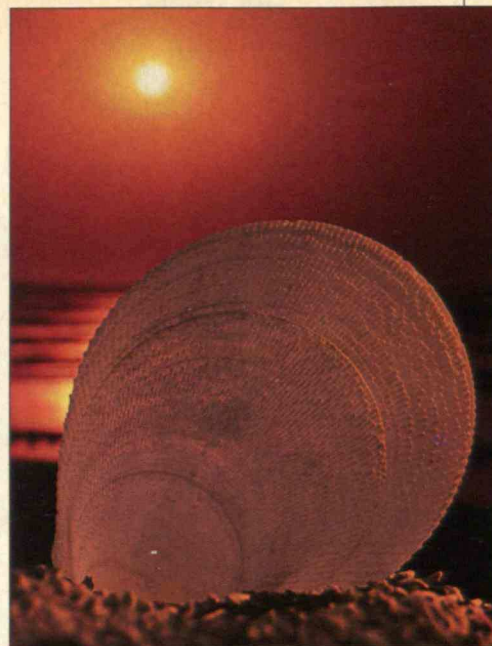
Industry officials maintain that foreign sales—and events like the Paris Air Show that encourage them—are in the U.S. interest. According to the AIA’s Johnson, when a company exports a particular weapon, the unit cost for making it drops, and the savings are passed on to the Pentagon.

In some cases, the extra sales may keep assembly lines open. The State and Defense departments told Congress earlier this year that “the long-term survival of a number of important domestic arms programs are tied to foreign sales: M1A1 Abrams battle tank, Blackhawk helicopter, Hawk surface-to-air missile, [and] Boeing 707 aircraft, to name a few.”

Johnson suggests there are less quantifiable benefits as well, such as supporting a U.S. defense industrial base. Moreover, he adds, lending a helping hand to events like the Paris show burinishes the nation’s military reputation, since visitors see the weapons they would face if they confronted the United States. “If Saddam Hussein had attended a couple of Paris air shows, he might have made a different call.”

Still, it’s too soon to know if the publicity will boost sales, even if crowds did flock to the U.S. pavilion. “One wouldn’t expect to see someone sidling up to the counter the day after the Paris Air Show” to place an order, Johnson says. “This isn’t a used-car lot. You don’t sell anything off the lot.”

—VINCENT KIERNAN (*The author covers military issues for Space News.*)



Imitations of Life

In materials science, nature inspires technology. Biological matter often displays wonderful qualities lacking in synthetic ones, and the hope of simulating nature’s creativity has given rise to the fledgling field of “biomimicry.” The result could be materials, for example, that are flexible yet resistant to extreme temperatures or pliable yet precise enough for electronics.

“We’re really talking about a new group of materials,” says University of Arizona materials scientist Paul Calvert. For years, Calvert has studied seashells, which are strong and light but not brittle.

The key is what are known as organic-inorganic compounds. Organic substances tend to be light, yielding, and flexible. Inorganics are strong and hard but typically heavy and brittle. Natural organic-inorganic compounds, such as seashells, intricately weave the two together to act as a single unit that preserves the benefits of each.

However, artificially homogenizing organic and inorganic materials is no mean task. The crystals must all have the same size, shape, and orientation. “It’s like trying to roll a clump of sand in a wad of chewing gum,” explains Pennsylvania State University chemist Patricia Bianconi. “They don’t mix easily.”

That’s why Bianconi’s combination of the mineral cadmium sulfide with polyethylene oxide could be a break-



A synthetic material (left) mimics the microstructure—and perhaps the strength—of the bessbeetle's shell (right).



Learning from Nature

Extrapolating Bianconi's breakthrough to a wide variety of organic-inorganic combinations could revolutionize materials synthesis for both biological and technological uses.

Consider the potential for artificial bones.

A living, dynamic tissue, a bone gradually adapts to changing tensions such as weight loss or gain. This adaptive ability, called remodeling, is based on two types of cells. First, osteoclast cells worm through existing bone, forming tunnels. Next, the second kind of cells, osteoblasts, deposit new bone. Current "artificial bone" materials are merely structural supports—osteoclasts can't penetrate them. But artificial bones fashioned from biomimetics could interact with the body's bone-forming cells. According to Brent Constantz, chief scientist of Norian Corp., a California firm experimenting with artificial bone tissues, future biomimetics might let the body's remodeling system replace artificial material with native bone.

Jon Block, vice-president of Advanced Biosearch Associates in San Francisco, believes the process could be taken further to prevent fractures owing to osteoporosis, in which osteoclasts break down more bone than osteoblasts replace. The condition makes it hard for

people to move freely, damages posture and the mechanical functions in wrists and hips, and causes over 1 million fractures each year in the United States alone. "If we had a way of actually enhancing the amount of bone that the body produced, we could prevent a lot of these problems," Block says.

Scientists are also exploring industrial uses for biomimicry. At Wright-Patterson Air Force Base in Ohio, materials scientist Steve Gunderson from the University of Dayton Research Institute is studying the hard outer shell of the bess-beetle with an eye toward advancing parallel composites for aerospace applications. "We're trying to develop new designs using nature as a model," says Gunderson.

Two key properties of the beetle's exoskeleton are its specific strength and damage tolerance. The former measures the strength of a material relative to its density, while the latter refers to a material's ability to sustain damage and still function. Gunderson attributes those qualities in the beetle's exoskeleton to its composite makeup and believes the lessons to be learned could lead to lighter, longer-lasting airplanes.

In the electronics industry, investigators at Bell Labs and elsewhere are exploring the photonic and electromagnetic potentials of biomimicry. If inorganic crystals could be precisely aligned within a biomimetic compound, molecules with special electromagnetic properties could be used to form channels that transmit atom-thin widths of light. With these "light pipes," says Bianconi, communications networks and supercomputers might run thousands of times faster than today's most sophisticated systems.

"Nature has produced wonderful materials with excellent properties that we can never dream of achieving if we don't explore her way of doing things," says University of Washington materials scientist Mehmet Sarikaya. "In the future," he adds, "biomimetic materials may even be superior to biological, natural materials." But for now, it's technology imitating life. —MUBARAK S. DAHIR

through in biomimetic synthesis. The cadmium-sulfide crystals of her lab-grown compound are indeed all one size, all one shape, and all oriented in the same direction within the polymer. "This is the first synthetic composite to copy these important characteristics of living tissues," she says.

While Bianconi's composite has no direct use in its present form, her advance, says Calvert, is "probing the control mechanisms of production." The submolecular precision in the way nature arranges components underlies the desirable properties of biological materials. In a procedure that took her two years to fine-tune, Bianconi has effectively duplicated nature's ability to do that.

"We tried it the way we know it happens in biological systems," explains Bianconi. She started with the polymer and put the cadmium on it. "Then we let the sulfur reagent impinge on the film that had formed as the product of the previous reactions, and that caused crystals to grow."

Bianconi says her method of growing crystals "on site" is contrary to the traditional technique for materials science. Usually, researchers bring together previously formed compounds and look for the best way to physically or chemically bond and combine them.

"One can start to see the parallels between this totally artificial system and the equivalent biological systems," Calvert notes.

It took Patricia Bianconi three years to duplicate nature's ability to combine organic and inorganic substances.



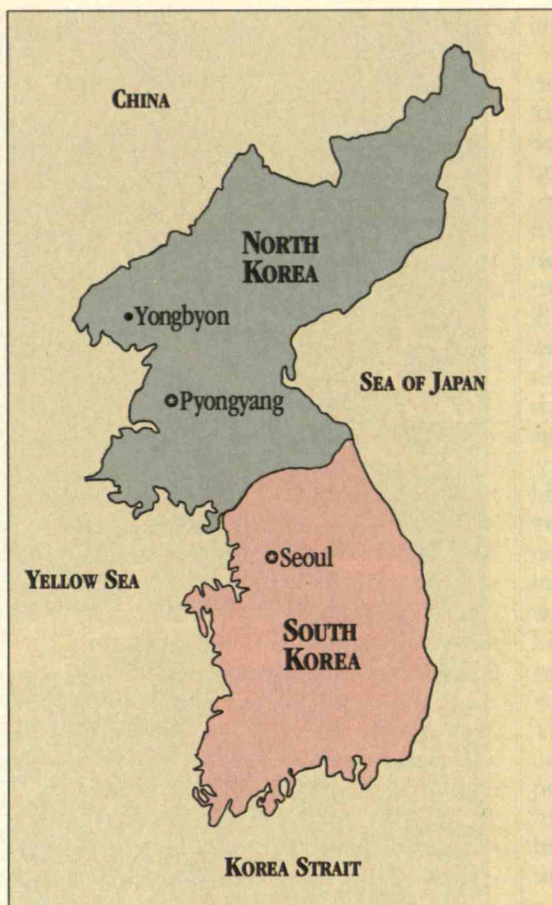
Korea's Nuclear Enigma

For the fourth time in a half century, the Korean Peninsula is a focal point of concern about nuclear weapons. During World War II, Japan located its version of the Manhattan Project in the hills behind the city of Hungnam in present-day North Korea. In the Korean War, President Harry S. Truman and Gen. Douglas MacArthur hinted at their willingness to drop atomic bombs on the North or China. In the 1980s, the United States may have pressured South Korea to abandon plans to acquire a nuclear arsenal.

Now U.S. and South Korean officials are raising the possibility of a new danger. Speaking at the University of California at San Diego last year, assistant secretary of state for East Asian and Pacific affairs Richard H. Solomon declared, "We view nuclear proliferation on the Korean Peninsula as the number one threat to stability in East Asia."

The anxiety revolves around North Korea's possible nuclear ambitions. U.S. and South Korean intelligence agencies have suggested that North Korea—a country ruled by an aging Stalinist patriarch—might be developing nuclear weapons at a 20 to 30 megawatt reactor at Yongbyon, some 60 miles north of the capital city of Pyongyang. In the South Korean journal *Hogkuk*, So Yong-ha, a researcher at Seoul's National Defense Intelligence Headquarters, has written, "The time frame for potential North Korean production of a nuclear weapon will be the mid-1990s."

The U.S. government is somewhat more circumspect than Yong-ha. "North Korea [is] pressing to develop unprecedented military capabilities, from ballistic missiles to weapons of mass destruction," Solomon says. Another State



U.S. and South Korean intelligence agencies suspect North Korea of developing nuclear weapons at Yongbyon.

Department official, who requested anonymity, cites classified intelligence reports and would only say, "I don't know that we're convinced North Korea is developing nuclear weapons. I'd say the correct word is concerned."

Nevertheless, non-government researchers have cited U.S. officials to support worries about North Korean plans. In *Foreign Policy*, Andrew Mack, director of the Peace Research Center at the Australian National University, writes, "The debate within the [U.S.] government centers on when North Korea will get the bomb, rather than on whether it seeks to do so."

Still, the evidence is, as Mack de-

scribes it, "circumstantial, fragmentary, contested, and often contradictory." As a result, it also generates skepticism. "Kim Il Sung [North Korea's ruler] might have nuclear ambitions, but I haven't seen concrete evidence of it," observes Walden Bello, co-author of *American Lake: Nuclear Peril in the Pacific*.

Tension Relief

The concern centers on the large nuclear research reactor at Yongbyon. According to South Korean media reports, U.S. spy satellites have spotted a reprocessing plant there that could extract plutonium for bombs from spent reactor fuel. Also, South Korean newspapers say a "high-explosives testing site" has been detected in the vicinity.

The Yongbyon facilities might mean that North Korea is developing nuclear weapons, but skeptics doubt that the country has the technical capacity to do so, especially since its relations with the Soviet Union have soured. The Soviets and the North Koreans

both insist the North doesn't have the technological ability to make nuclear weapons.

Because hard evidence is scarce, Andrew Mack, along with Leonard Spector and Jacqueline Smith of the Carnegie Endowment for International Peace, have looked at the circumstances that might affect Kim Il Sung's nuclear ambitions. For example, North Korea has become increasingly isolated as its allies—notably China and the Soviet Union—have improved their relations with South Korea. That has left the North to rely more on its own defenses, while the South has rapidly bolstered its conventional forces. Although North Korea's army remains larger, the South has sped ahead in technology—including nuclear technology.

Such trends alter the delicate balance that has helped keep a tenuous peace on

the peninsula since 1953. Both North and South have offered diplomatic initiatives, but Spector and Smith describe diplomatic movements to reduce tension as incremental. This leaves the two sides nervous about their respective military weaknesses. Thus, the North may perceive "a growing strategic need for nuclear weapons," notes Mack. "For instance, [North Korean] nuclear weapons targeted against the South could deter U.S. nuclear strikes on the North in any North-South conflict."

North Korea's refusal to open its Yongbyon facilities to inspection by the International Atomic Energy Agency fuels further questions about its ambitions. Pyongyang committed itself to inspections in 1985 by signing the Nuclear Non-Proliferation Treaty, but it has yet to agree with the agency on implementing these safeguards.

North Korea says it will open the Yongbyon facilities to international inspection if the United States withdraws its nuclear weapons from South Korea. However, the United States, consistent with its global practice, refuses to either confirm or deny the presence of nuclear weapons, although most analysts believe it stores them in South Korea.

The State Department says the Non-Proliferation Treaty obliges North Korea to open its facilities to inspection without conditions. Argues the anonymous State Department official, "That's not contingent on anything the United States does or doesn't do." Still, Spector and Smith say, the United States could help defuse tension by strengthening assurances that it wouldn't use nuclear weapons against North Korea.

Mack suggests a larger step, and one that some State Department officials appear to support. "The United States and [South Korea] have no greater common security interest than preventing Pyongyang from going nuclear," he argues. "The removal of U.S. nuclear weapons from the South may achieve that end, and given the marginal strategic value of these weapons, [it] is an option worthy of serious consideration." —JAMES P. GOODNO



This double-decker train could carry local passengers through Yosemite Park along tracks laid on a highway right-of-way.

A Solar Solution for Yosemite

Yosemite National Park has an urban problem. More than a million cars enter the park each year, and at times during the summer, the Yosemite Valley resembles Los Angeles at rush hour, complete with gridlock and the bleak haze of air pollution.

That's one reason the National Park Service is considering a proposal to solve the dilemma with a solar-powered railroad. Since 1980, the park service has become desperate to eliminate automobiles from Yosemite, notes assistant park manager Frank Dean.

A solar train would go a long way toward achieving that goal, thinks Christopher Swan, a transportation designer based in San Francisco. His solar railroad would link up with Amtrak at the Central Valley city of Merced, Calif., and run through El Portal, just outside the park's western entrance. Landscaped track would then wind through the seven miles of Yosemite Valley and loop around ridges above it.

The nonpolluting train would use ordinary tracks, but it would draw on the power of the sun. A photovoltaic skin blanketing the top of the train would provide for lights, refrigeration, heating, and other electrical needs inside. As for the system that would actually drive the train, Swan envisions either of two basic designs, depending on technological advances over the next five years—the length of time he hopes it will take to fund and build the project. In either case, each car would be self-propelled, containing several electrical motors, and photovoltaic cells would cover the roofs of rail stations spaced at 10-mile intervals. Because each car would have its own motors, trains could be any length for versatility and energy efficiency.

In Swan's first scenario—which appears more likely to be implemented ini-

tially—traditional batteries would be installed in each car. With today's batteries, trains can run from 120 to 150 miles on a charge at slower speeds, which is good enough for the Yosemite train. It would not exceed 25 miles per hour and could get used batteries replaced with freshly charged ones at the stations. However, better batteries would have to be developed for faster trains outside the park.

Swan's second scenario involves hydrogen-powered fuel cells. In this system, the stations' photovoltaic cells would be used to distill water, which would be separated into hydrogen and oxygen, and the hydrogen would be pumped into a tank of glass microspheres heated to 400-500° F. These tiny spheres, which would absorb hydrogen for safe storage and loading, would be reheated on the trains. The hydrogen would then escape its glass encasement to run a fuel cell, yielding electricity for the engines. The only by-products would be glass and pure water, both of which could be reused.

According to Swan, NASA has demonstrated this technology in the space shuttle, while Soviet engineers have used it in a prototype supersonic transport. "The technology is already here," he says. "It is just a matter of some application engineering." Among other things, a space shuttle is a much more highly controlled environment than a train. Also, a train would need a

much larger power system.

Since many park concessions rely on automobile traffic, Swan's proposal calls for eliminating most commercial buildings from Yosemite. Sunscreen, maps, books, hiking equipment, and other supplies would be sold from train cars parked at sidings near trail heads. When supplies ran out, the car would roll to El Portal for restocking—delivery trucks would become obsolete.

As John Muir Found It

The major obstacles to a solar train, says Swan, aren't technical; they are political and financial. He thinks the project would cost \$2.2 billion.

Swan has spent a year meeting with local, state, and federal officials to raise funds for a demonstration project. This prototype, a seven-mile train through Yosemite Valley, would cost about \$20 million. And while the reaction to the idea of the prototype seems favorable, the eventual price tag remains a formidable obstacle. "The guy's a kind of a dreamer, but there is nothing wrong with that," says Stephen Medley, executive director of the 6,000-member Yosemite Association. "The real question [is], are we willing to shell out the dough?"

To cover some of the \$2.2 billion price tag, the project would generate about \$100 million annually from carrying 3.2 million passengers, Swan notes. It would also save several million dollars every year by reducing the cost of road maintenance. And Swan believes that companies eager to show off products developed for the project could

contribute as much as \$100 million.

Most of the money would have to come from federal, state, and local funds, as well as from real estate taxes on property developed around the stations. "The government should take the same approach to this project as it does toward multi-billion-dollar defense projects," says Swan. "It justifies them in part because of all the new technologies and products that will be spun off. We will be demonstrating to the world a new transportation technology—one that is nonpolluting, highly efficient, and applicable globally."

Beyond finances, not everyone is happy about the idea of leaving their vehicles outside the park. "The most negative letter I've received came from a man who complained that I wanted to take his recreational vehicle away from him," says Swan. "In California, many people still equate their automobiles with personal freedom."

Similarly, relocating concessions and accommodations to El Portal creates a political hot potato. "Making El Portal the favored gateway into the park puts [us] in a precarious position with the three other gateway communities," says assistant park manager Dean. "Ultimately, however, a choice would have to be made for the preservation of the park."

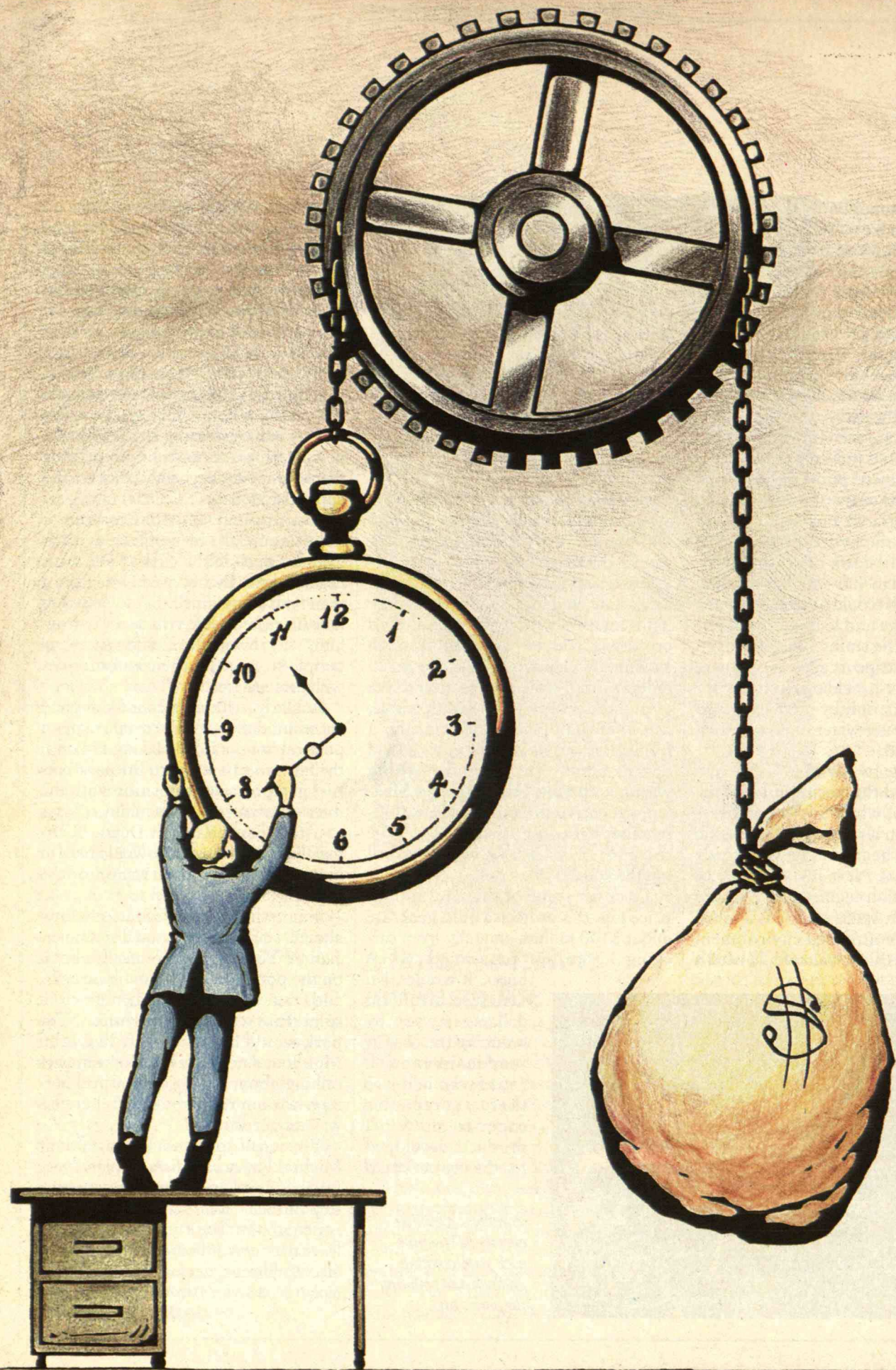
Swan, who wrote YV88, an eco-novel about a solar-powered and de-commercialized Yosemite, and *Suncell*, a book on the potential of photovoltaic cells, adds that the ecological benefits of a solar train would be enormous. "The park would be much more like John Muir found it," he says. "We're always talking about saving our natural heritage for our children—well, here's a way we can do that."

Yosemite park superintendent Michael Finley calls Swan's plan "very feasible," and even takes the concept a step further. "Real success for a [solar] railroad plan has to allow people to leave their cars at home. It has to take in all of California, not just the park." Such a plan is on Swan's drawing board.

—MICHAEL BOWKER



More than a million cars enter Yosemite each year, creating gridlock and polluting the park's air.



Workers of the World, Unwind



IN the last 20 years, the amount of time Americans spend at their jobs has risen steadily. Each year the change has been small, amounting to about nine hours, or slightly more than one additional day of work. But the accumulated increase over two decades is substantial. Today's work year of 1,949 hours is 163 hours—almost a month—longer than in 1969.

Not surprisingly, as work rises, leisure falls. People report nationwide that their leisure time has declined by as much as a third since the early 1970s. According to one survey, Americans have only 16½ hours of leisure a week after taking care of the obligations of job and household.

The leisure crunch didn't have to happen. Whenever productivity grows, we are presented with the possibility of receiving either more free time or more money—and since 1948, the productivity of the U.S. worker has more than doubled. In other words, we could now produce our 1948 standard of living (measured in marketed good services) in less than half the time it took in that year. We could have chosen a

four-hour day. Or a working year of six months. Or each worker in the United States could now be taking every other year off from work, with pay. Some economists in the 1950s even predicted that today's standard retirement age would be 38.

But between 1948 and the present, we did not use any of the "productivity dividend" to reduce hours. Although productivity grew rapidly—at about 3 percent a year—in the first two decades after 1948, work hours have held steady. Since 1969, productivity growth has been slower, averaging just over 1 percent a year. Yet hours have risen markedly.

What went wrong? Why has leisure been such a conspicuous casualty of prosperity? Much of the answer lies in our insidious cycle of "work-and-spend."

In its starkest terms, the cycle operates like this: Employers ask for long hours from employees. They do so in part because long-hour jobs pay more and thus are more desirable to workers, who will labor more productively to keep them. Also, the fewer workers a firm needs to hire, the less it has to spend on fringe benefits. The high pay, in turn, creates a high

We don't

have to work ourselves to death.

Government, business, and individuals can take action to balance labor with leisure, while actually boosting productivity.

By
JULIET B. SCHOR

ILLUSTRATIONS BY BRUCE MADDOCKS

Although the work week hasn't grown much in 20 years, the number of work weeks in a year has. The figures are the author's estimates based on the Bureau of Labor Statistics Current Population Survey. They exclude unemployed and underemployed workers.

RIISING HOURS FOR FULLY EMPLOYED U.S. WORKERS

	HOURS WORKED PER YEAR		
	1969	1987	INCREASE
All workers	1,786	1,949	163
Men	2,054	2,152	98
Women	1,406	1,711	305

	HOURS WORKED PER WEEK		
	1969	1987	INCREASE
All workers	39.8	40.7	0.9
Men	43.0	43.8	0.8
Women	35.2	37.0	1.8

	WEEKS WORKED PER YEAR		
	1969	1987	INCREASE
All workers	43.9	47.1	3.2
Men	47.1	48.5	1.4
Women	39.3	45.4	6.1

HOURS WORKED PER YEAR IN MANUFACTURING

	1970	1979	1989
Belgium	1,870	1,638	1,572
Canada	1,918	1,859	1,887*
Denmark	1,829	1,639	1,595
France	1,872	1,712	1,610
Germany (West)	1,889	1,717	1,603
Italy	1,905	1,738	1,858
Japan	2,269	2,159	2,155
Netherlands	1,893	1,669	1,592
Norway	1,794	1,572	1,614
Sweden	1,744	1,513	1,539
U.K.	1,939†	1,886	1,856
U.S.	1,913	1,907	1,951

*1988 †1971

Not only do European factory workers put in shorter hours than their U.S. counterparts, but their work-load has been steadily shrinking.

level of consumption. People buy houses and go into debt; luxuries become necessities; Smiths keep up with Joneses—and workers accept, or even ask for, longer hours so they can go on spending. Work-and-spend has become a powerful dynamic keeping us from a more relaxed and leisured way of life.

If hours keep rising, it's hard to see how we can solve the accompanying crises of family—the problems of child care and the strains of marriage—or the adverse health effects of stress and overwork. And then there's the health of the environment: further rounds of work-and-spend will only multiply the amount of natural resources we use up and pollutants we spew out.

Can America Afford Less Work?

Not everyone accepts the need for more leisure. A 1989 letter from work-time expert William McGaughey, Jr., to 300 business leaders advocating a shorter work week

JULIET B. SCHOR is an associate professor of economics at Harvard University. After slaving over her forthcoming book, *The Overworked American: The Unexpected Decline of Leisure* (Basic Books, copyright 1991)—from which this article is adapted—she is taking it easy, having a baby, and planning to work one-quarter time for the next year.

failed to yield a single favorable response. This reply from the CEO of one Fortune 500 company was typical: "My view of the world, our country, and our country's needs is diametrically opposite of yours. I cannot imagine a shorter work week. I can imagine a longer one both in school and at work if America is to be competitive in the first half of the next century." In one *Fortune* poll, three-quarters of CEOs took the view that competing with the Japanese will require them to "push their managers harder." Its fierce opposition even to unpaid parental leave suggests that business thinks it can't afford any concessions.

Of course, employers have been sounding the alarm of foreign competition for at least a century and a half. In 1830, New York employers opposed the 10-hour day on grounds that it would allow foreigners to undersell them. Their laborers put forth the other point of view, in a debate that has changed little since then. An article in *The Working Man's Advocate* asked: "Are we to slave 13 or 14 hours a day, because the Manchester spinner or the Birmingham blacksmith so slaves?"

In fact, the vast majority of America's competitors work far less than we do. When business executives claim that Americans must work harder, they show selective vision, looking only East, to Japan or South Korea. In Japan, not only do half the workers pass up vacation time but many work a six-day week. In manufacturing—the sector where most foreign competition takes place—Japanese workers put in six weeks more each year than do their counterparts in the United States. But U.S. workers are already doing eight weeks more than their French and western German peers and eleven more than Swedes. The West Europeans have managed to maintain their standard of living, cutting neither wages nor time off.

Discrepancies in work time are often cited as if they were proof enough that the U.S. must replicate Japanese ways. But the economics of competition is not the economics of mimicry. It's more complex. First, we must be clear about what business leaders are asking for. If it's more hours at existing pay, then it is merely a roundabout way of reducing workers' wages. While lower wages help competitiveness in the short term, in the long run they can boomerang, as declining wages lead to declining productivity, through diminished incentives to invest, lower employee morale, and higher turnover. The game of lowering wages can get insidious. Once the highest in the world, U.S. manufacturing wages have fallen substantially for a decade, and now rank below many West European nations. How far down should they go? Korea, Brazil, and India are growing competitors. If corporations demand a decline to the poverty wages paid in such countries, should American workers simply accede?

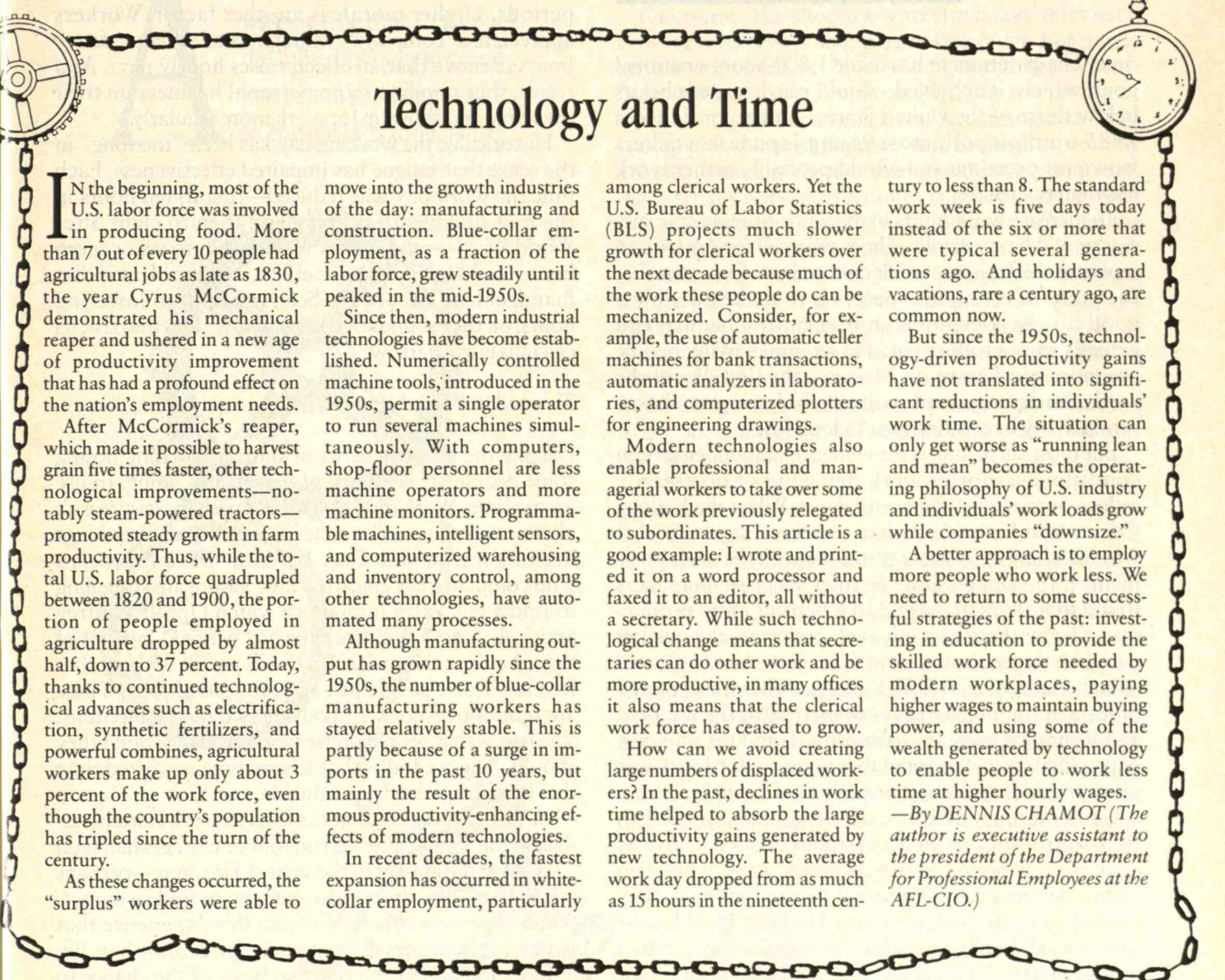
What we should learn from the Japanese, and from our own history, is not the need to reduce wages, or raise hours, but the importance of productivity. In the

international market, what matters in the long run is not how many hours one works but how productively one works them. If an American can produce an equivalent computer in fewer hours than a Japanese (at a comparable wage rate), then that computer will sell, whether the American works a 50- or a 40- or a 30-hour week. And efficient production itself will yield rising wages, as the cases of Japan and Korea reveal. Instead of pushing their employees' standard of living even farther down the global hierarchy, U.S. management should be figuring out how to make the hours they buy more productive.

The irony of corporate America's position is that in Japan excessive hours are a serious problem. Consider the white-collar "salarymen," who adhere to grueling schedules in a pressure-cooker environment. They face

arduous commutes, an extended work day, and obligatory "after work" socializing. They are strongly discouraged from taking their vacations. In recent years, Japan's vibrant economy has brought overtime hours near their all-time high. The result: untold numbers of workers have become victims of "karoshi," or "death by overwork." Otherwise perfectly healthy, they keel over at their desks, usually after a prolonged stretch of overtime or a particularly high-pressure deal.

Significantly, a recent Japanese government study found that the nation's productivity, despite its high growth, is lower than that of other advanced countries in part because the working hours are too long. (According to the most recent figures, U.S. labor productivity is a third higher than Japan's.) And there is now considerable pressure in Japan to reduce work



Technology and Time

IN the beginning, most of the U.S. labor force was involved in producing food. More than 7 out of every 10 people had agricultural jobs as late as 1830, the year Cyrus McCormick demonstrated his mechanical reaper and ushered in a new age of productivity improvement that has had a profound effect on the nation's employment needs.

After McCormick's reaper, which made it possible to harvest grain five times faster, other technological improvements—notably steam-powered tractors—promoted steady growth in farm productivity. Thus, while the total U.S. labor force quadrupled between 1820 and 1900, the portion of people employed in agriculture dropped by almost half, down to 37 percent. Today, thanks to continued technological advances such as electrification, synthetic fertilizers, and powerful combines, agricultural workers make up only about 3 percent of the work force, even though the country's population has tripled since the turn of the century.

As these changes occurred, the "surplus" workers were able to

move into the growth industries of the day: manufacturing and construction. Blue-collar employment, as a fraction of the labor force, grew steadily until it peaked in the mid-1950s.

Since then, modern industrial technologies have become established. Numerically controlled machine tools, introduced in the 1950s, permit a single operator to run several machines simultaneously. With computers, shop-floor personnel are less machine operators and more machine monitors. Programmable machines, intelligent sensors, and computerized warehousing and inventory control, among other technologies, have automated many processes.

Although manufacturing output has grown rapidly since the 1950s, the number of blue-collar manufacturing workers has stayed relatively stable. This is partly because of a surge in imports in the past 10 years, but mainly the result of the enormous productivity-enhancing effects of modern technologies.

In recent decades, the fastest expansion has occurred in white-collar employment, particularly

among clerical workers. Yet the U.S. Bureau of Labor Statistics (BLS) projects much slower growth for clerical workers over the next decade because much of the work these people do can be mechanized. Consider, for example, the use of automatic teller machines for bank transactions, automatic analyzers in laboratories, and computerized plotters for engineering drawings.

Modern technologies also enable professional and managerial workers to take over some of the work previously relegated to subordinates. This article is a good example: I wrote and printed it on a word processor and faxed it to an editor, all without a secretary. While such technological change means that secretaries can do other work and be more productive, in many offices it also means that the clerical work force has ceased to grow.

How can we avoid creating large numbers of displaced workers? In the past, declines in work time helped to absorb the large productivity gains generated by new technology. The average work day dropped from as much as 15 hours in the nineteenth cen-

tury to less than 8. The standard work week is five days today instead of the six or more that were typical several generations ago. And holidays and vacations, rare a century ago, are common now.

But since the 1950s, technology-driven productivity gains have not translated into significant reductions in individuals' work time. The situation can only get worse as "running lean and mean" becomes the operating philosophy of U.S. industry and individuals' work loads grow while companies "downsize."

A better approach is to employ more people who work less. We need to return to some successful strategies of the past: investing in education to provide the skilled work force needed by modern workplaces, paying higher wages to maintain buying power, and using some of the wealth generated by technology to enable people to work less time at higher hourly wages.

—By DENNIS CHAMOT (*The author is executive assistant to the president of the Department for Professional Employees at the AFL-CIO.*)

While U.S. workers average two weeks' paid vacation a year (and the Japanese take only a week and a half), Europeans enjoy at least a month off.

PAID VACATION IN EUROPEAN COUNTRIES

COUNTRY	BY LAW	BY CONTRACT
Austria	5 weeks	Same
Belgium	4 weeks	5 weeks
Denmark	—	5 weeks
Finland	5 weeks	5 to 6 weeks
France	5 weeks	5 to 6 weeks
Germany	3 weeks	5½ to 6 weeks
Greece	4 weeks	Same
Iceland	4 weeks, 4 days	Same
Ireland	3 weeks	Approx. 4 weeks
Italy	—	4 to 6 weeks
Luxembourg	5 weeks	25 to 30 days
Malta	4 weeks	Same
Netherlands	4 weeks	4 to 5 weeks
Norway	4 weeks, 1 day	Same
Portugal	30 civil days	4½ to 5 weeks
Spain	30 civil days	4½ to 5 weeks
Sweden	5 weeks	5 to 8 weeks
Switzerland	4 weeks	4 to 5 weeks
U.K.	—	4 to 6 weeks

time. The government has made 1,800 hours a national goal, which, if achieved, would put Japanese hours below those of the United States. And according to a 1985 opinion poll, most young Japanese workers frown on overtime and would probably rather work less than earn more.

To increase work hours in the name of economic success would be sheer folly. Those who call for America to replicate the Japanese work culture have forgotten that the point of economic success is to make possible a good life. Besides, some shorter-hour schedules can actually raise productivity. For example, many people are more productive on Monday, the first day of the week. An arrangement such as job sharing can boost productivity by creating two "Mondays."

But most surprising is the evidence that under certain conditions a shorter work day will not necessarily reduce output, and can even raise it. When the Kellogg Co. made its historic switch to a six-hour day in 1930, it was searching for a strategy to cope with the unemployment of the Depression. To their surprise, managers found that workers were 3 to 4 percent more productive. The workers were pleased, preferring the quicker pace but shorter hours. And management was pleased as well. According to W.K. Kellogg, "The efficiency and morale of our employees is so increased, the accident and insurance rates are so improved, and the unit cost of production is so lowered that we can afford to pay as much for six hours as we formerly paid for eight."

Contemporary evidence tells a similar story. When the Medtronic Corp. in Minneapolis decided to give its employees 40 hours' pay for 36 hours' work, it hired no additional personnel but found that output increased. On balance, the company saved money. Ideal Industries, a small family-owned business in Chicago, shifted to a four-day, 38-hour week—also at 40 hours' pay. Again, productivity did not decline, but absenteeism did. At the United Services Automobile Association

insurance company in Texas, sales were up, even though personnel hours were down. Efficiency and morale improved, turnover and error rates declined. These experiences have been repeated in other U.S. companies, as well as in foreign firms. A British study of a variety of companies reached similar conclusions. Far from being costly, nearly all these work-week reductions paid for themselves, even when workers' incomes were held steady.

One reason is that when hours are shorter, workers can physically and mentally sustain more intense effort. Another is that the work day gets compressed. The typical work day contains unproductive time, either scheduled (such as official break and meal times) or unscheduled (such as gatherings around the water cooler). As Chris Nyland, an economist at Australia's University of Wollongong, has argued, when management cuts the work week, what actually shrinks is often these idle periods. Higher morale is another factor. Workers appreciate a company's willingness to schedule fewer hours (a move that, in effect, raises hourly pay). As a result, they conduct more personal business on their own time and show up for work more regularly.

Historically, the working day has been "too long" in the sense that fatigue has impaired effectiveness. Each time the work day was reduced—first to ten hours in the mid-nineteenth century and then to eight after World War I—productivity rose. A shift to six or seven hours could have a similar effect. The problem is that management has always been resistant to lowering hours, on the grounds of cost. But now, as in the past, its calculus is too narrow.

Toward a Saner Lifestyle

Despite the many benefits of shorter working hours, some people are skeptical of Americans' ability to use leisure time. Work may be bad, but perhaps leisure isn't all it's cracked up to be either. According to Brookings Institution economist Gary Burtless, "Most Americans who complain they enjoy too little leisure are struggling to find a few extra minutes to watch Oprah Winfrey and *L.A. Law*." Will free time be "wasted" in front of the tube or at the mall? What will we do with all that leisure? Won't people just acquire second jobs? These are serious questions, embodying two main objections. The first is that people prefer work, or if they don't they should. The second is that leisure time is wasted time that is neither valued nor valuable.

It's always possible that the urge to work is irrepressible. In the 1950s, after Akron rubber workers had won a six-hour day, many of the men at Firestone—perhaps one in five—also drove cabs, cut hair, or sold insurance. Some observers concluded from this experience that American workers do not want, or cannot handle, leisure time. If they are right, so be it—if the chance to work shorter hours, when fairly presented, is not appealing, then people will not take it. But before we

accept the Akron experience as definitive, it may be worth asking *why* so many took a second job.

The male rubber workers were reasonably well paid by the blue-collar standards of the day, and many of their wives worked. They did not labor out of sheer economic necessity. Very likely they were driven more by a cultural imperative—the one that says men with leisure are lazy. It is significant that women rubber workers did not seek a second paycheck.

Today there are signs that this cultural imperative is weakening. Perhaps most important is the transformation of sex roles. Women have taken up more responsibility for breadwinning. And men are more comfortable around the house. In a recent *Time* magazine poll of men between the ages of 18 and 24, nearly half said

they would like to stay home and raise their children. The ethos of “male sacrifice” is disappearing: fewer people believe that being a “real man” entails self-denial and being the family provider.

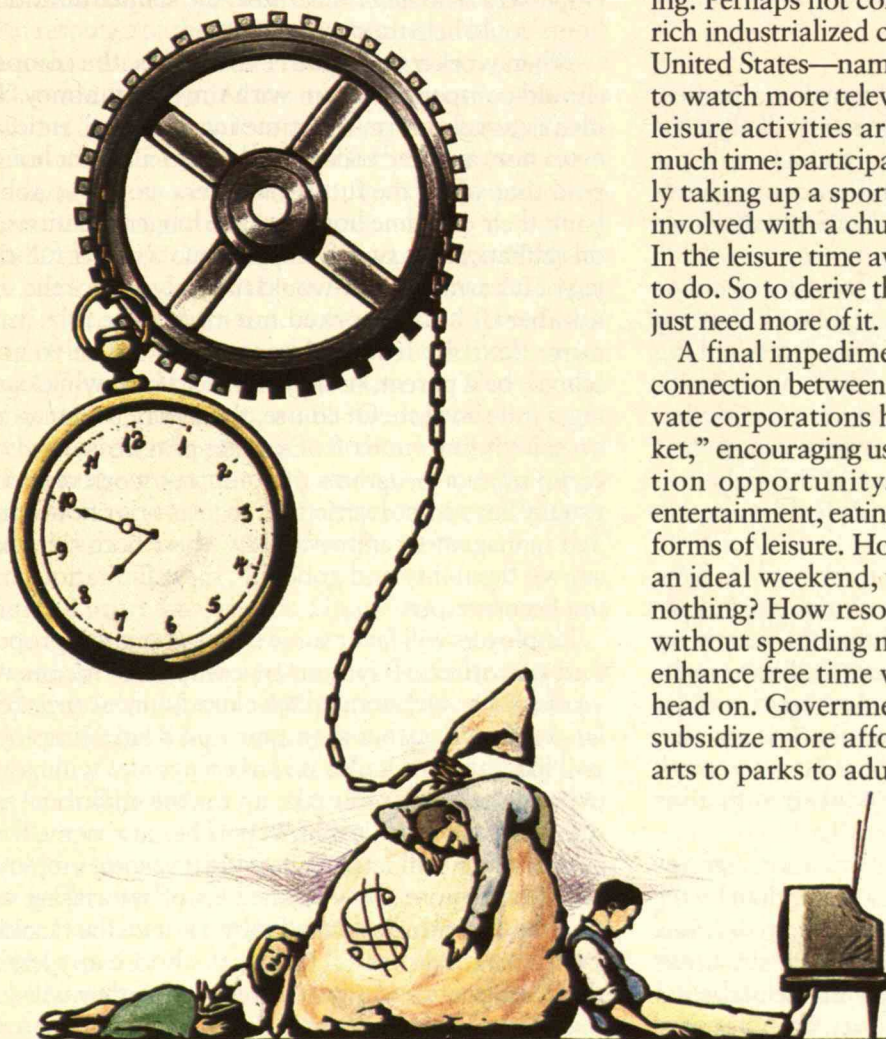
The traditional work ethic is also undergoing transformation. Commitment to hard work retains its grip on the American psyche. But ideas of what work is and what it is for are changing. The late 1960s and the 1970s witnessed the rise of what some have called “post-materialist values”—desires for personal fulfillment, self-expression, and meaning. Throughout the industrialized world, a culture shift occurred as young people especially began demanding satisfying work. Even the burst of old-style materialism during the 1980s did not permanently dislodge what now looks like a long-term trend. People are expecting more from work than a paycheck and more from life than what 1950s culture offered.

Of course, the skeptics who cite heavy television viewing or excessive shopping have a point. But it may be that work itself has been eroding our ability to benefit from leisure time. People could just be too tired after work to engage in active leisure. According to a 1986 Gallup poll, the most popular ways to spend an evening are all low-energy choices: television, resting, and reading. Perhaps not coincidentally, the globe's only other rich industrialized country with longer hours than the United States—namely, Japan—is also the only nation to watch more television. Many potentially satisfying leisure activities are off limits because they take too much time: participating in community theater, seriously taking up a sport or a musical instrument, getting involved with a church or a community organization. In the leisure time available to us, there's less of interest to do. So to derive the full benefits of free time, we may just need more of it.

A final impediment to using leisure is the growing connection between free time and spending money. Private corporations have dominated the leisure “market,” encouraging us to think of free time as a consumption opportunity. Vacations, hobbies, popular entertainment, eating out, and shopping itself are costly forms of leisure. How many of us, if asked to describe an ideal weekend, would choose activities that cost nothing? How resourceful are we about doing things without spending money? A successful movement to enhance free time will have to address this dynamic head on. Governments and communities will need to subsidize more affordable leisure activities, from the arts to parks to adult education. We need a conscious effort to reverse the “commodification of leisure.”

The transformation in people's relationship with their work must therefore be not only economic and social but cultural and psychological. On all these fronts there are some

Americans are accused of wasting free time in front of the tube, but people could just be too tired after work to engage in active leisure.



hopeful signs. Some forward-looking companies have been waking up to the realities of their employees' lives. Wells Fargo gives personal-growth leaves, Xerox offers social-service sabbaticals. Job sharing is possible at a growing number of companies, including Hewlett Packard, Black & Decker, TRW Vidar, and Levi-Strauss. Control Data has a flourishing part-time program that includes benefits. Anna Roddick, founder of the Body Shop grooming-aid chain, gives her employees a half-day off each week with pay to engage in volunteer activities. While the number of innovative corporations is still small, it is rising.

And there is growing public awareness of the need for change. For the first time since such surveys have been systematically conducted, a majority of Americans report that they are willing to relinquish income to gain more family and personal time. In a 1989 poll conducted for Robert Half International, a California firm, almost two-thirds said they would prefer to give up some of their salary, by an average amount of 13 percent; fewer than a quarter were unwilling to give up any money at all. Although this is just one study, its findings are intriguing; they offer hope that Americans may be ready to change their overly demanding work lives.

Timely Innovations

Despite the actions of a few enlightened companies, recent history shows that increased leisure is likely to be opposed by most businesses. More free time will not result from market forces or the munificence of technology. It will come only when people devise specific ways to achieve it.

The idea of establishing a right to free time is not as utopian as it sounds. The state has regulated working hours since the colonial period, and has legislated the right to free time in the form of legal holidays—not to mention the social security system, which assumes that workers have a right to leisure toward the end of their lives. What I propose is the extension of this right—so that everyone can enjoy free time while they are still young and throughout their lives.

To gain this right—to reduce the reliance on long hours—it will be necessary to break the work-and-spend cycle. That means first of all that the incentives for employers to demand long hours will have to be weakened. Second, employees will need opportunities to convert work into free time instead of money. Through a number of relatively simple changes in work laws, it should be possible to accomplish both aims without causing U.S. productivity to suffer.

One group of workers for whom structural reforms are necessary are those paid on salary rather than by the hour. Since salaried workers don't qualify for overtime, companies have an incentive to squeeze as many hours out of these employees as they can. To put the brakes on this practice, firms should have to pay for what they

now receive courtesy of their salaried work force; they ought to be required to attach a standard schedule to every job. Along with annual pay, each position would also have an explicit number of hours—for example, a nine-to-six schedule—and a specified number of holidays, vacation and personal days, and sick days. Ideally, the firm would designate an annual total of hours and allow flexible scheduling within it.

Of course, many salaried positions already have official weekly hours, even if they're not adhered to. And paid time off is almost always specified in advance. But standard hours would be a departure in many of the longest-hour fields, such as finance, consulting, upper administration and management, and law. While employers could set any amount of hours as the standard, they could only request—not demand—that an employee work extra hours, and the worker would have to be compensated for them.

This system would not be a cure-all for the excessive hours of some occupations. But competition for personnel may discourage employers from setting very long days. If a prospective trainee at Salomon Brothers were asked to guarantee 80 hours and Goldman, Sachs sets 70, the former would be at a disadvantage. For those employees who *want* their time, the standardization of hours could help them get it.

When workers do put in extra hours, the company should compensate them with time, not money. The idea is to transform overtime into "comp" time. An extra hour worked today would yield an extra hour of paid time off in the future. Workers would be able to bank their overtime hours to take longer vacations, go on sabbatical, or switch to part-time work at full-time pay. This arrangement would not only reduce the total number of hours worked but also make jobs much more flexible. It would become far easier to go to school, be a parent, or do volunteer work while carrying a full-time job. Of course, there may be limitations on scheduling time off. Existing practices involving comp time or programs of voluntary work reduction usually have some restrictions such as prior notification and management approval. But where both sides have shown flexibility and goodwill, these limitations have not been onerous.

Employers will favor some things about this proposal and not others. Payment by comp time means that workers are remunerated for extra hours at their regular wage rate, rather than time and a half. Employers will like this. But it also means companies will have to expand their staffs to make up for the additional time off. They will not like that, in part because of the fringe benefits they will have to provide. I suspect employers will be still more averse to the idea of associating standard hours with all salaried jobs. Despite the flexibility built into the proposal (they can choose any level of standard hours and adjust it frequently), they will complain that it is an unnecessary intrusion on their prerog-

A majority of Americans surveyed say they are willing to relinquish income to gain more family and personal time.

atives. But management has sounded this refrain over many successful benefits in the past.

Meanwhile, many hourly workers would bitterly oppose the elimination of overtime pay, at least at the beginning. Overtime is the only way they can earn high, or even livable, incomes—a circumstance that has turned more than a few into slaves to their jobs. But here the solution should be livable wages, not unlivable schedules.

The idea that jobs pay more where overtime is available is to some extent an illusion. A recent study by Stephen J. Trejo, an economist at the University of California, Santa Barbara, shows that workers who get overtime receive lower hourly wages, as firms “undo” some of the effect of the overtime premium. If this research is correct, it is likely that hourly wages would rise in response to the elimination of overtime.

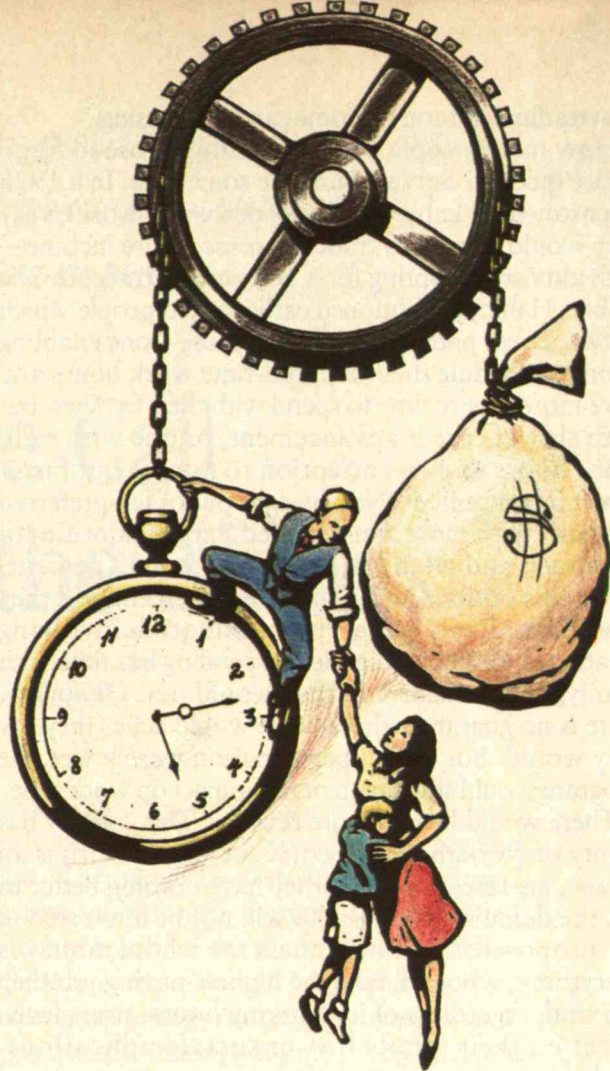
Another much-needed change is to make part-time work more feasible. At the moment, most part-time positions are low-pay, low-mobility, and largely without benefits. The impediments for professionals and managers are especially difficult; in many places, part-time is tantamount to career suicide.

Some simple reforms would smooth the way for part-time work. A first, crucial step is to eliminate the fringe benefits penalty. Part-time workers would receive a share of health insurance, pension benefits, and other fringes, prorated by their hours of work. They would also get the option to go to full coverage at their own expense. A second option is to institute job sharing, in which two people split one position's fringe benefits, responsibility, work, and pay. Each of these changes would reduce biases toward long-hour jobs.

Trading Future Income for Time Off

To sever the link between pay raises and increased consumption, we must exploit the psychological difference between income that is already being spent and income that is merely expected. According to most surveys, people cling tenaciously to their current paycheck, unwilling or unable to trade it for time. But polls also indicate strong sentiment for using *future* income to fund additional time off. Suppose companies were required by law to give people a choice between raises and free time.

The company would announce the percentage pay increase it plans to give each group of employees. Then



it would calculate equivalent hours of time off. The employee could decide among the alternatives—from the extremes of all pay or all time, to various fractional splits in between. The company could offer different forms of time off (reductions in daily hours, part-time schedules, or additional vacation or personal days). Free time could be accumulated from year to year.

How would this choice work out if it were available today? There are two key parameters: the rate of income growth the company is willing to provide, and the fraction of increased income that workers designate toward free time. Let's assume the former is 2 percent plus an adjustment for inflation, and the latter is 100 percent. Then, about a decade from now, the average work year will have fallen from 1,949 hours to 1,600 hours a year. If a firm offered faster income growth—4 percent a year—annual hours could drop to 1,300, allowing workers to go to school one semester a year, take a four-month vacation, or work a five-hour day.

If it sounds too good to be true, remember that in this example purchasing power is completely stagnant. People who go 100 percent toward free time for 10 years will experience no increase whatsoever in their material standard of living. Purchasing power will keep up with inflation, but not exceed it. If you can be content tomorrow with the amount you consume today, however,

then trading off future income can be a blessing.

How many people would actually choose to forgo future income? Survey data give some idea. In a 1978 Department of Labor survey, 84 percent of workers say they would choose to trade off *some* future income—with almost half opting for a 100 percent tradeoff. The Robert Half poll mentioned earlier asked people which of two career paths they would choose—one enabling them to schedule their own full-time work hours and have more leisure time to spend with their families, but with slower career advancement, or one with rigid work hours and less attention to family, but faster career advancement. Nearly eight out of ten preferred the path with more time. Indeed, large majorities of both men and women (74 percent and 82 percent) chose this option. And although 34 percent said they would be “likely to accept a promotion involving greater responsibility if it meant spending less time with family,” 55 percent said they would not. Of course, there is no guarantee that people would act as they say they would. But even if participation were lower, the program would still have a major impact on work time.

There would be hard-core resisters. This country has plenty of workaholics—people for whom work is an escape, an obsession, or, if they have nothing better to do, the default option—who will not be interested in my proposal. There are others for whom money is everything, who will take the highest-paying job they can find, regardless of its working hours, stress level, effect on their family life, or social implications. And among the male population, many are ensnared in the traditional breadwinner role, as well as by the tendency of our culture to equate self-worth with job and pay.

Nevertheless, the idea of giving up money for time might become more palatable to such workers as their colleagues spread the word about their newfound leisure—and happiness. A case in point is a group of overtime-loving workers in a British shoe factory. When hard times hit, the plant went into work sharing, and employees who had chased after all the extra hours they could get—including Sundays and holidays—now found themselves with time on their hands.

One worker reported: “Bit by bit, there was an unbelievable phenomenon of physical recuperation. The idea of money really lost its intensity. I don’t mean it had disappeared, but eventually even the blokes with families to look after said, ‘It’s better now than before.’ It’s true that we lost a good deal of money [25 percent of former income] . . . but, quite soon, only one or two of the blokes minded.

“It was about now that . . . friendships began: we were now able to go beyond political conversation, and we managed to talk about love, impotence, jealousy, family life. . . . It was also at this time that we realized the full horror of working in the factory on Saturday afternoons or evenings. Before, the blokes had put up

with it, but now we were once again learning the meaning of the word living.”

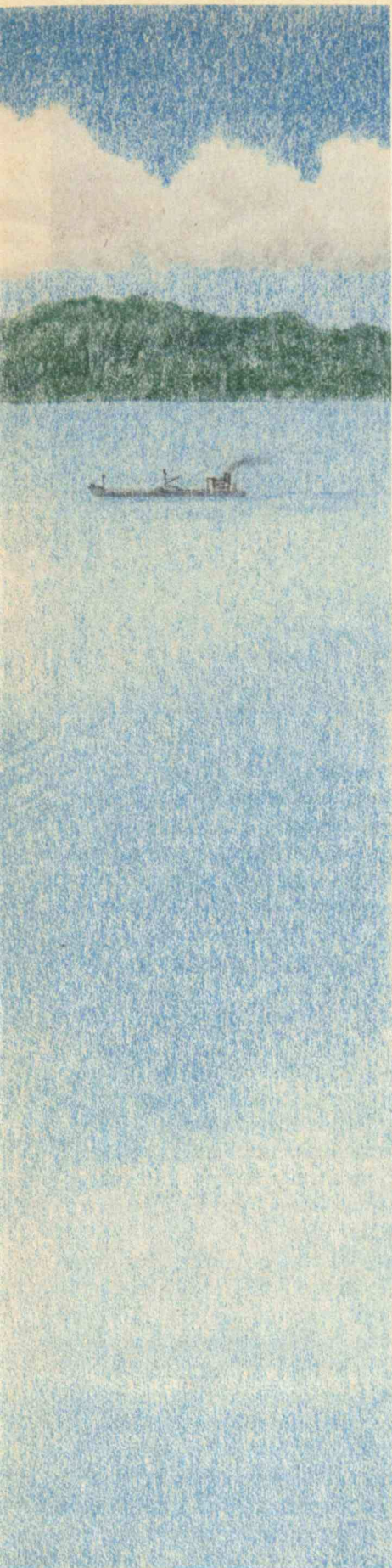
Of course, the wages of many Americans are so low, or their conditions of employment so precarious, that they cannot afford to give up any income—present or future. And their ranks are swelling. Nearly a third of all U.S. workers currently earn wages that, on a full-time schedule, are insufficient to lift them out of poverty. Millions can make ends meet only through overtime, moonlighting, and multi-earner families. And many are unable to make ends meet at all.

The danger of increasing leisure time voluntarily is that it could replace inequality of income with inequality of time. The poorest third would work just as many hours as ever—or more, as more work became available—while the top two-thirds would gradually become a leisured class. The people who would gain free time would be those who already had the financial resources that make it possible: education, homes, and a bank account. They would be mainly white and mainly upper and middle class.

Ultimately, solving inequality of time means redressing the underlying inequality of income—say, by raising the minimum wage and reducing the large differences in pay that exist within most companies. But in the meantime, there are other ways poorer workers can gain more leisure time. In addition to *voluntary* increases, I advocate *mandatory* increases in free time. The United States stands out among rich countries in its failure to ensure basic rights to vacation or parental leaves. What about government-mandated four-week paid vacations for all employees, independent of length of service? Or six-month paid parental leaves, financed through the social security system? These would be a step in the right direction.

My proposals also run the risk of reproducing inequalities of gender. The suggestions themselves—such as making part-time work more desirable or allowing people to trade off income for time—are gender-neutral. But without change in underlying gender roles, women will be more likely to take advantage of them. If this occurs, it will perpetuate women’s responsibility for housework and childcare. Therefore, feminists’ continuing efforts to equalize the division of labor within the family are crucial to the larger success of my proposed reforms. If men take considerably more responsibility for children and housework—as many now say they want to—then they too will want to opt for working patterns that are compatible with family duties. In that event, the proposals would help undermine rigid gender roles, by making shared parenting and two-career families more feasible.

If men and women work together and demand a right to time from their employers and government, the nation might at last be able to slow down, unwind, and start enjoying the time dividend that modern technology and values make more feasible than ever. ■



Artificial offshore islands can be the answer to urban congestion, polluted harbors, and inadequate ports.

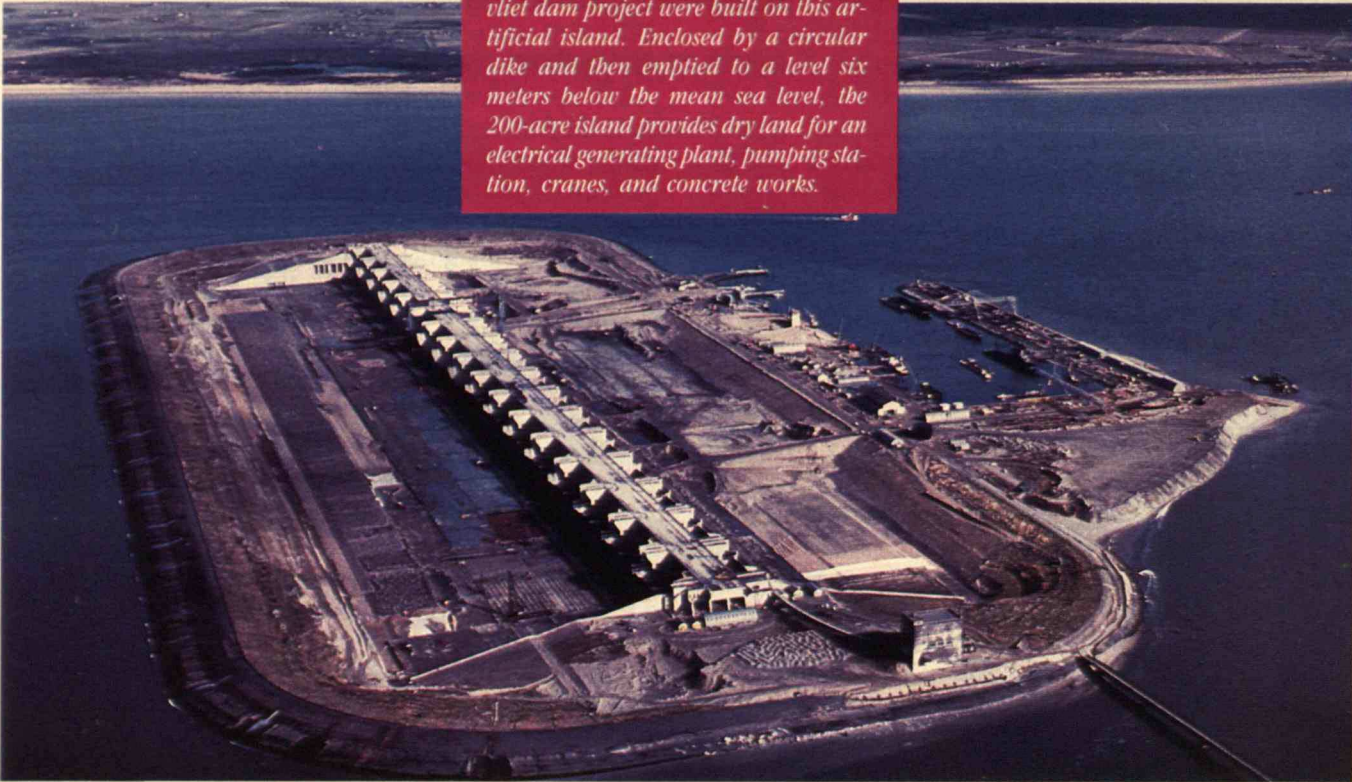
The Call of the Islands

BY ERNST G. FRANKEL

JUST ten years ago, Tokyo Bay was a polluted, stagnant body of water: smelly, visually opaque, and nearly devoid of marine life. Today the city has turned that situation around, and a big part of the reason is a technology other troubled ports could use as well—artificial offshore islands (AOIs). Large platforms or filled areas designed to support such industrial activities as storage, transportation, resource-processing, and waste disposal, AOIs can be located in shallow or deep water. They can be built by “reclaiming” land—that is, by diking and filling—or by sinking rigid legs known as gravity caissons. AOIs can also be floating platforms of various types that are either largely prefabricated or constructed at the site.

Not only do AOIs help remedy current ills, but they can forestall future ones, some of which officials have not prepared for at all. For example, a multi-billion-dollar effort is under way to clean up the notoriously polluted Boston Harbor, but there are no plans to deal with one of its most significant sources of pollution: the oil terminals in the inner harbor. At least one tanker grounding or collision occurs each month in a U.S. port, and though Boston has been lucky so far, one serious tanker accident could negate much of the cleanup effort. The storage and transfer of oil—as well as of liquid natural gas and other hazardous commodities—occupy about 600 acres of waterfront land. The harbor could be spared, and other benefits (such as deeper ports) could be realized if these terminal facilities and industries were relocated to AOIs.

The idea of artificial offshore islands is not new; as



Sluice-gates for the Netherlands' Haringvliet dam project were built on this artificial island. Enclosed by a circular dike and then emptied to a level six meters below the mean sea level, the 200-acre island provides dry land for an electrical generating plant, pumping station, cranes, and concrete works.

long ago as 1932, a floating mid-Atlantic landing field was proposed as a refueling station to extend the range of commercial aircraft. Only recently, however, have growing environmental and economic pressures pointed to opportunities for many other uses. AOIs are being developed worldwide to serve as terminals for large ships, distribution bases, factory sites, oil platforms, power plants, airports, aquafarms, fishing bases, marinas and resorts, hospitals, silos and storage facilities, solid and toxic waste disposal facilities, and even residential areas.

In Japan nearly three dozen large reclaimed AOIs serve as port terminals or bases for port-related industry, replacing expensive urban land. Six AOIs have been built in Singapore, where population pressures make land scarce, and 18 in Holland, where the technology protects existing land from flooding. Over 100 more AOIs have sprung up around the world, joining several thousand of the more familiar offshore oil drilling and production platforms.

Several reasons often combine to make artificial islands attractive, as demonstrated by Coal Island, now under development in Japan's Inland Sea. The island is designed to replace the open coal stockpiles of near-

ly 20 coal-burning electric power plants in densely populated coastal cities such as Kakogawa, Takamatsu, Onomichi, and Hiroshima. The plants will be served by one 60-acre stockpile at a central offshore receiving terminal, saving about 200 acres of coastal land. Coal from the stockpile island will be delivered to shore by 30,000-ton shuttle barges that will dock at the berths already in place at each power plant, freeing prime waterfront land next to each plant and eliminating coal dust and groundwater pollution caused by the stockpiles.

The Coal Island scheme will therefore allow improvements in air and groundwater quality and present an opportunity to redevelop scarce waterfront land for recreation or tax-earning residential and commercial use. Also, coal transport costs will drop, and coal inventory holding costs will be reduced by 75 percent, or about \$40 million per year.

Another innovative use of AOIs are the floating cement plants built in the Netherlands for Nigeria in the late 1970s. These islands combine a cement mill with bulk silos, automated bag loading and transfer machinery, and facilities to store raw materials for cement. Typically located near a construction site in need of large amounts of cement, the AOIs can be docked adjacent to other similar platforms that support the manufacture of reinforced concrete beams, girders, or panels. Sand for the concrete can often be dredged from the ocean bottom by equipment mounted on the same platform.

ERNST G. FRANKEL, professor of ocean engineering at MIT, has served as adviser for ports and shipping at the World Bank and as senior adviser to the United Nations International Maritime Organization. For nearly 20 years he has helped plan and develop artificial islands in Japan, India, Singapore, Israel, and other countries.

An Environmental Asset

The costs of constructing an AOI and its protective dams and other infrastructural facilities are often high compared with the costs of developing land onshore. Maintenance and operating links to the mainland are added expenses. Also, legal constraints can hinder new construction on the seabed in areas under international or conflicting local jurisdictions. For example, no AOIs have yet been located in international waters beyond the 200-mile territorial limit because the U.N. International Seabed Authority has been unable to develop a legal mechanism to grant permission for such projects.

But assuming that the legal and financial obstacles can be overcome, the design options for AOIs are many. AOIs can be built on-site by constructing a perimeter wall and filling the area enclosed. The facilities can also be prefabricated and tethered into place for floating operations, or sunk in place as gravity-caisson-supported structures that serve as relocatable terminals (See the illustrations on pages 37-38). The design choice depends on projected use, the sensitivity of the natural environment at the site, and conditions such as waves, currents, tides, water depths, and bottom soils.

Adverse environmental effects can be minimal if the AOIs are of the floating type, because they do not affect conditions on the ocean bottom. Conversely, gravity caissons supported on the ocean bottom as well as reclaimed islands do disrupt marine breeding grounds and affect bottom flows. As a result, significant changes in erosion or soil buildup on nearby coastal shore may occur. Another problem is that hazardous materials in the fill used for reclamation may seep through the bottom and pollute not only bottom soils but also shallow aquifers.

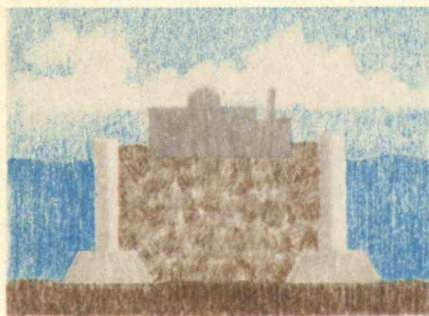
However, because industrial and urban pollution has often seriously degraded the local environment beforehand, most AOIs built in the last two decades have had little if any net detrimental impact. Even massive AOI developments such as those off Singapore or in Tokyo Bay have actually improved water quality, fish habitat, and coastal protection.

The structures provide shelter and reduce tidal velocities, allowing suspended nutrients to settle to the seabed where they form rich feeding areas for fish and other creatures. In the Gulf of Mexico and the Persian Gulf, for example, fishers often find their best hauls around offshore oil drilling platforms.

Proper safeguards can help eliminate undesirable effects. In Japan, builders have controlled destructive underwater currents by constructing underwater dams, thereby eliminating erosion. They have detoxified fill materials before use, and placed layers of fiberglass under the fill to prevent leaching. When caisson-supported platforms have been used in biologically sensitive areas, the caissons have often been placed on stilts or support piles, maintaining an effective clearance above the bottom.

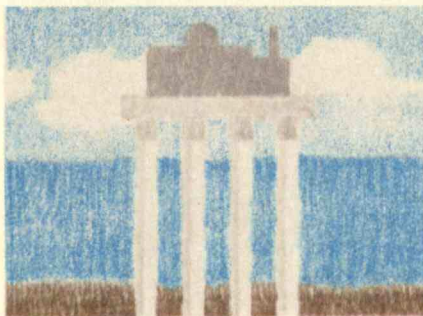
Industries relocated on AOIs typically use new equipment that operates much more cleanly than the earlier onshore sites. Most are constructed with strict controls and monitoring in place. Although the disposal of effluents such as cooling water and low-level toxic material may continue, emissions are much safer in the marine environment, where many compounds are quickly neutralized or decomposed. And because many AOIs are constructed 10 to 20 miles from urban concentrations, they are out of sight of any residential or recreational areas, so noise and aesthetic pollution are reduced. When AOIs do pollute, however, operators cannot deny

SEVEN DESIGN OPTIONS FOR AOI'S



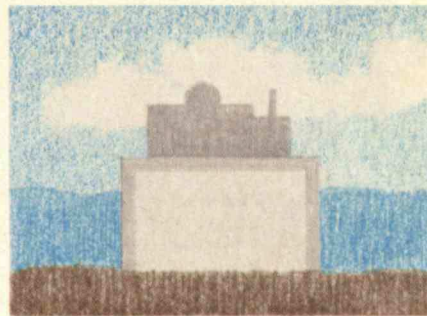
RECLAMATION

The sea area is enclosed by embankments. Fill is added. An island of this type is vulnerable to earthquakes but resists waves.



PILING

A platform is fitted onto piles driven into the seabed, and structures are built on top. This type also resists waves but is affected by earthquakes.



BOTTOM-FIXED

A structure built on rigid legs or a floating body is towed to the ocean construction site, where it is sunk and installed. This type is suitable for relatively shallow water, but the seabed must be readjusted before installation.

it: Because the islands are isolated from other urban or industrial sources of pollution, it is much easier to monitor, identify—and control—sources of environmental damage.

As a fringe benefit, AOIs present a unique opportunity to dispose safely of solid, toxic, and radioactive wastes. For example, Japanese companies have used diluted liquid radioactive waste experimentally as a mixing and cementing agent in casting large cement blocks, which are contained in a reinforced outer concrete casing (made with pure cementing water) that shields the inner polluted cube. The blocks would be buried under 10 to 30 meters of solid sand fill and used as the foundation layer for a reclaimed AOI.

Such containment cubes are extremely strong, able to sustain the equivalent of a 50-foot drop onto a concrete pad without fracturing. Moreover, no leaching can occur through the waterproof outer casing, and the blocks are expected to have a structural integrity lasting at least 100 years, twice as long as the half-life of most radioactive isotopes in nuclear waste. All the radioactive waste generated by Japanese nuclear plants in a single year could be encapsulated under one 200-acre artificial island. By contrast, 2,500 acres of new AOI are built every year in Japan. Japanese research laboratories and regulatory agencies are now conducting detailed studies to determine whether this disposal method could be put to widespread use.

Case Studies: Tokyo and Goa

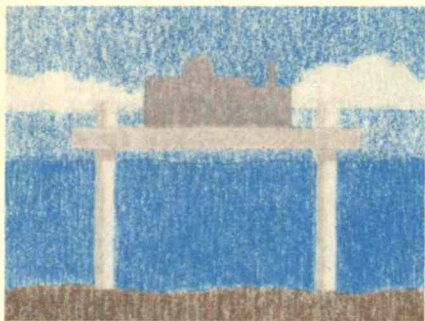
In the last 20 years no city in the world has undergone greater physical changes as a result of AOI construction than Tokyo. The city has added over 12,000 acres of prime land and quadrupled its waterfront since 1970, and most traditional waterfront activities have now

been relocated to AOIs. A further expansion of 6,000 acres is planned before the end of this century.

A comparison of aerial photos (*see page 40*) from 1965 and 1985 illustrates the radical change. The total area of municipal Tokyo has increased by nearly 17 percent since 1956. Before 1970 most of the increase in Tokyo came from land added along existing waterfronts only, but reclamation today is mainly offshore. These developments have prevented the economic strangulation of the city, allowing industrial and transport functions to gradually disengage from urban residential and business activities. The cost of reclaiming and improving AOIs in Tokyo Bay averages \$3 million per acre, a small fraction of the cost of waterfront land there.

When builders move polluting waterfront industries onto AOIs, they often install strict effluent controls, and carefully relocate the seabed breeding grounds affected. Nearly half the remaining sewage outflows from Tokyo have been moved or passed through treatment plants, allowing the residue to be used as fill in massive reclamation projects such as an expansion of Haneida airport. As a result of the relocation of industry to AOIs—coupled with these vigorous pollution control measures—the waters in the bay are clean today, and so is the air in the surrounding cities. Waterfronts once monopolized by ports and heavy industry again teem with recreational and commercial activity.

While Tokyo's new chain of artificial islands has served it well, and Osaka, Kobe, and Yokohama are rapidly catching up, a single AOI often fits the bill. In Goa, India, an artificial island provided the only economical solution to a shipping crisis in the mid-1970s. Iron ore shipped down the shallow Goa River by barges reached a bottleneck at the port of Goa, where the facilities were inadequate to load ore onto large, deep-draft carriers. The exports of millions of tons of ore to



JACK-UP

A structure built on a floating body is towed to the ocean installation site, where the entire apparatus is raised to the appropriate height on legs fixed to the seabed. Leg strength restricts the weight of the structure.



FLOATING

A structure built on a floating body is towed to the installation site and moored there. This type is affected by pitching waves, but is less susceptible to earthquakes.



SEMI-SUBMERSIBLE

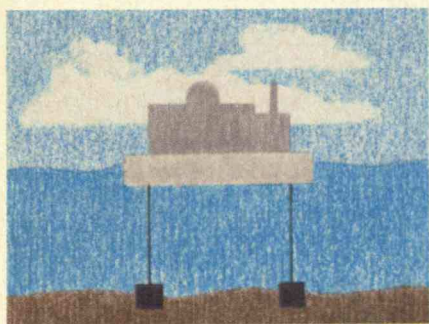
This stable floating platform is supported by struts resting on a buoyant, fully submerged body.



Above: A lack of deep-draft port facilities threatened India's iron-ore trade with Japan until this floating ore terminal was built off the city of Goa by the Mitsui Ocean Development and Engineering Corporation (MODEC). Constructed at one-tenth the cost

of a traditional pier and breakwater, the terminal allows ore to be loaded directly onto the large carriers used by the Japanese. Below: The 1,100-acre, \$4 billion Port Island in Kobe, Japan, was built between 1966 and 1981 to create new land for office buildings,

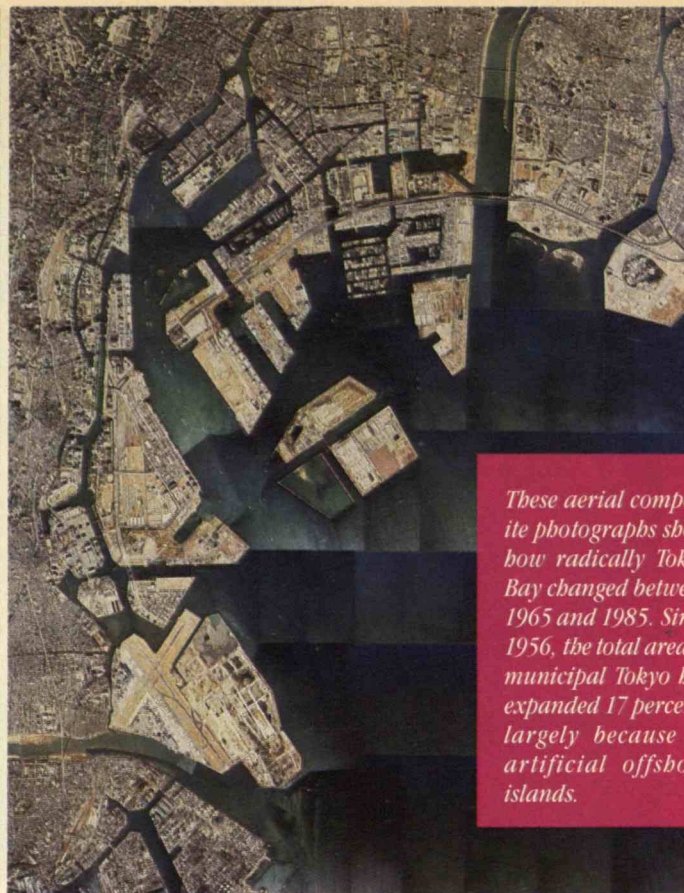
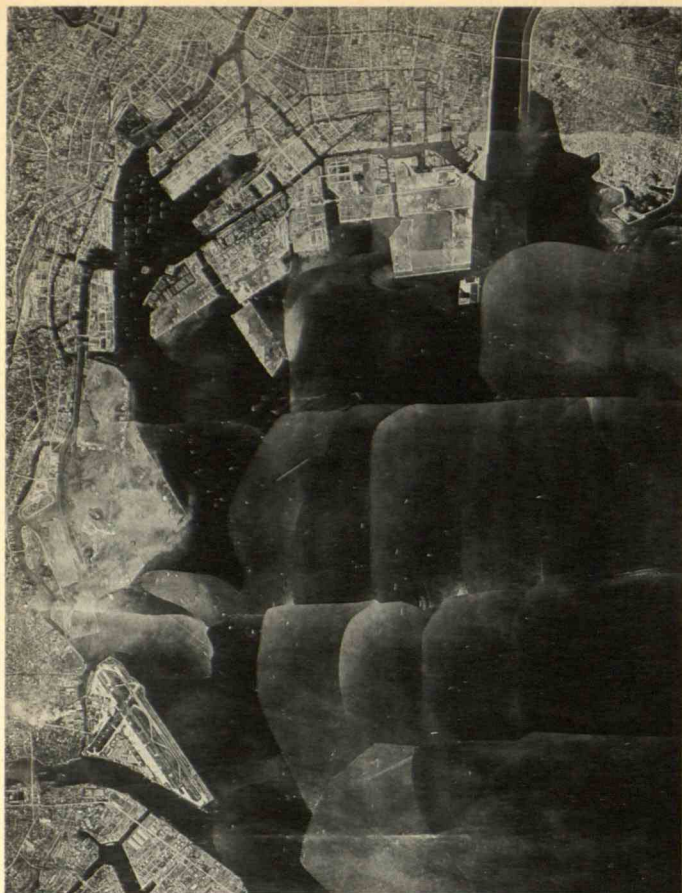
sports facilities, parks, warehouses, factories, shipping terminals, and residences, and more than 20,000 people inhabit it. In the lower right portion of this photograph, taken several years ago, reclamation continues. The island has since doubled in size.



TENSION LEG PLATFORM

This version of a stable semi-submersible platform is anchored by cables which are attached to the bottom of the sea and then tightened. Such a platform will not move or change floating depth as long as the cables remain taut.





These aerial composite photographs show how radically Tokyo Bay changed between 1965 and 1985. Since 1956, the total area of municipal Tokyo has expanded 17 percent, largely because of artificial offshore islands.

Japan were thereby endangered. One plan called for constructing a traditional port facility at the mouth of the river, including a two-mile-long breakwater/pier that would have taken over six years to construct at a cost of over \$200 million. The scheme would have required extensive dredging of the river bottom and port approaches, and would have caused significant changes in shore currents and sediment flows.

Instead, a semi-submersible catamaran AOI was constructed in a shipyard in Japan in less than six months, at a cost of less than \$20 million (*see the photo on page 39*). At this floating terminal, up to 60,000 tons of iron ore can be stored for loading into large oceangoing bulk carriers of comparable capacity, and the operating cost is much lower than at a traditional port. The iron ore trade has continued uninterrupted.

AOIs for the USA

The United States is the world's largest trading nation, yet the country has done little to develop AOIs. The nation possesses only a single deep-draft port—an offshore oil terminal in Louisiana—able to accommodate large tankers. This puts the U.S. at a distinct economic disadvantage, given that the inability of U.S. ports to accommodate large, efficient ships or to allow such ships to turn around in port quickly without spending many hours navigating through congested channels af-

fects the price of both imported and exported goods. Similarly, such maneuvers greatly increase the potential for ship groundings or collisions; the majority of such accidents occur in narrow port approaches. Finally, most of the 46 U.S. ports with depths of 40-52 feet (deep-draft ports are those with depths greater than 54 feet) require extensive dredging of approach channels, port basins, and alongside berths, which is troublesome in itself. Concerns about the safe disposal of dredge spoils and the effect of channel dredging on coastal soil movement have intensified.

AOIs could help solve these problems. They could be strategically located to provide deep draft ports, and at the same time they could work radical changes in urban environments by cleaning up or relocating ecologically objectionable industrial, commercial, and transport activities. Moreover, the shift to AOI technology need not be expensive. While urban waterfront land is priced in the United States at \$2-6 million per acre along deep water, AOI costs amount to only \$1-3 million per acre. The cost of a 100-acre artificial island for deep-water berths in Boston's outer harbor, for example, is estimated by us at about \$260 million. Service facilities might add another \$120 million. The freed coastal land, however, would be worth several times that amount. Thus, regardless of whether one is motivated by problems of trade or environment, AOIs offer an effective solution to both. ■

MIT

NOVEMBER/DECEMBER 1991



AUGUST 1946: GOODBYE RAD LAB, HELLO RLE

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COVER

The good news was, the war was over. The bad news was, so was Rad Lab. For those who signed on, working at Rad Lab was like being back in college—several thousand young people focused on solving problems, working all hours of the day and night, commiserating about the cafeteria lines at Walker—and a letdown was inevitable. But for Building 20, the end of Rad Lab opened up space for projects no one dreamed of in 1946. Photo from the MIT Museum.

THE "BALTIMORE CASE"

The article in the August/September issue of *Technology Review* by David Hamilton, '88 (pp. MIT 21-22), is by and large a good review of the "Baltimore case." Unfortunately there are a couple of very important things that are omitted. The first of these has to do with the hearings before the Subcommittee on Oversight and Investigation of the House Committee on Energy and Commerce, chaired by Rep. Dingell (D-Mich.). The article says: "According to one observer, 'To the scientists in the room, Baltimore won the argument, but others could see that David made a great mistake—he had humiliated Dingell in public.'"



Rep. John Dingell

What is omitted is that Baltimore had sent out quite a number (I recall something like 400, but I cannot substantiate this number) of letters to fellow scientists asking for their support at the hearings. It is also noteworthy that Baltimore was given the forum of *Technology Review* to present his side of the matter—e.g., *TR*, Aug/Sept. 1989, pp. 20 & 79 [A column entitled "Self-Regulation of Science"].

The second important item that is completely omitted from the article is "What happened to Dr. Margot O'Toole?" Nowhere is it mentioned that she was not reappointed to a position at MIT after apparently having been promised she would be. Further, it appears that she was "blackballed," for it is only recently that she was reemployed in her field. *Insight*, April 29, 1991, pp. 48-49, reported that "O'Toole suffered a fate common to whistle-blowers: She lost her job and was ostracized. Baltimore labeled her a malcontent."

I know there is a limited amount of space in *Technology Review*, but why not give a little of it to the person who suffered the most in this mess—Dr. Margot O'Toole?

THOMAS H. GOODGAME, ScD '53
Alamogordo, N.M.

CREATIVE GRADUATE IDENTIFIED

The name of the graduate on the cover of the August/September MIT section was unknown to us at the time. But thanks to Ben Lowengard of the Media Lab, he has been identified as Michael B. Johnson, SM '91 (Course IV)—Ed.



GAZETTE

MIT ALUMNI JOB LISTINGS

- ▶ A bi-weekly bulletin giving employers the opportunity to reach experienced MIT graduates, and MIT graduates the opportunity to scan the market.
- ▶ If you are an employer looking for talent, or an MIT graduate looking for new directions, contact Bonny Hafner at the address below.
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\$27M Keeps Magnet Lab Funded for Four More Years

One year after losing out to Florida State University in a bid to be the home of the new National High Magnetic Field Laboratory (NHMFL), the Francis Bitter National Magnet Lab at MIT has won a new short-term lease on life. The National Science Foundation announced in August that it will award up to \$23 million to the Magnet Lab over the next four years, and an additional \$4 million in NSF-authorized funds will come from Florida.

The infusion of \$27 million will enable MIT to continue serving the 300 to 400 scientists from around the country who use its existing magnets, ranging in strength from 8 to more than 30 tesla and to forge ahead with its longstanding plans to design and build a world-record 45 tesla class magnet to be used at the FSU facility. (One tesla equals a magnetic field 20,000 times the strength of the Earth's magnetic field.) The Bitter Lab is now funded through September 1995, when the NHMFL is expected to become fully operational.

Magnetic fields are used to examine the nature of materials in the fields of physics, materials science and engineering, chemistry, biology, and computer science. The current world record for a steady magnetic field is held by the MIT lab for a 31.8 tesla magnet, which has been in service since 1981. That record will be superseded this fall when the lab puts a 35 tesla magnet into service. Meanwhile, the Japanese are working on a 40 tesla magnet, to be finished in 1994.

The \$9 million, 45 tesla magnet that is on the drawing board will combine superconducting magnets and water-cooled resistive magnets. The combination is essential to achieve the maximum field. Super-

conducting magnets consume very little power, but cannot produce fields much above 15 tesla. Resistive magnets consume enormous amounts of power and are limited in field strength by the heat which must be dissipated. The maximum fields are obtained by placing a resistive magnet inside the bore of a large superconducting magnet, producing a combined field effect.

The higher field magnet is expected to make possible new discoveries about how electrons move in semiconductor devices, and the highest fields possible are necessary to elucidate the properties of the new high-temperature superconducting materials. Past history has shown that even modest increases in field have enabled important scientific advances; research using the 45 tesla magnet may have significant impact on future generations of electronic devices, according to Bitter Lab Director David Litster, PhD '65.

The NSF's decision last year to award the NHMFL to Florida State came as a big surprise to MIT, since three merit review panels had recommended MIT as best in terms of "its proven record of excellent performance in science, magnet technology, and access for the user community." The NSF maintained that FSU had demonstrated more enthusiasm and a stronger commitment to creating a new national center of excellence than MIT. (See page MIT 2 in the January 1991 Technology Review.)

In July, Provost Mark Wrighton had contacted the chancellor of the Florida state university system to express MIT's willingness to cooperate with FSU in the

transition to the new facility. Of the joint venture to build the new magnet, an NSF announcement quoted NHMFL Director Jack Crow as saying that his laboratory "is very excited about collaborating with MIT on this project. These interactions will exemplify the outstanding tradition and research accomplishments that have characterized the Francis Bitter National Magnet Laboratory." □

Suh to Head Mechanical Engineering

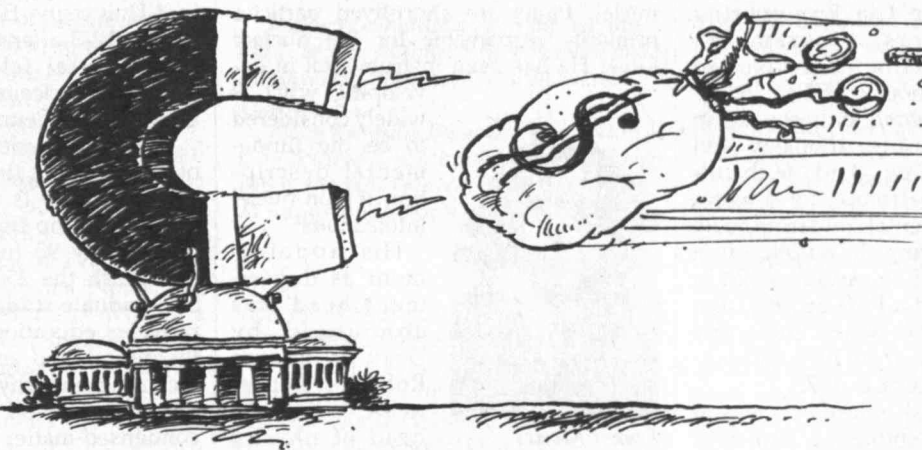
Professor Nam P. Suh, '59, a mechanical engineer who has made important contributions to the science of manufacturing and mechanical engineering, has been named head of the Department of Mechanical Engineering.

He succeeds Professor David N. Wormley, '62, who was named associate dean of the School of Engineering in January. Suh's appointment was announced by Dean Joel Moses, PhD '67.

Suh, described by the departmental search committee as an assertive leader with drive and imagination, was cited for his "exceptionally good relationship with industry and government" and his ability to articulate the department's objectives to various constituencies both within and outside MIT.

The Ralph E. and Eloise F. Cross Professor of Manufacturing at MIT, Suh is internationally respected for such

achievements as the development of a series of patented processes for the manufacture of metals and polymers, the formulation of the delamination theory of wear, and the development of a set of axioms for designing manufacturing processes. He has written more than 200 papers and four





A surprise fiftieth birthday party for Chuck Vest at Fenway Park in early September coincided with MIT's Night at the Sox. In spite of a scoreboard tribute and Associate Provost Ellen Harris singing the national anthem from home plate, the Sox lost, 2-0.

books and has been awarded 30 patents for inventions in manufacturing and materials processing.

In addition, Suh has been a pioneer in the development of university-industry research collaboration. In 1973 he founded the MIT-Industry Polymer Processing Program, considered the prototype for university-industry collaboration through a research consortium. In 1977, he also founded the Laboratory for Manufacturing and Pro-

ductivity, now an interdepartmental laboratory within the School of Engineering. Suh directed the program and the laboratory until 1984, when he was appointed assistant director for engineering at the National Science Foundation by

President Reagan. During his four-year tenure at NSF, he introduced a new organizational structure and new programs, including the Engineering Research Centers program, to strengthen engineering education and research. He returned to MIT in 1988.

His current research projects are in design, manufacturing, tribology and materials processing. And, with colleagues in the department, he is working on a fundamental undergraduate text in manufacturing. In addition to a bachelor's degree, Suh earned an SM in 1961 from MIT and a PhD in 1964 from Carnegie Mellon. He joined the faculty as associate professor in 1970 and was promoted to professor in 1975.

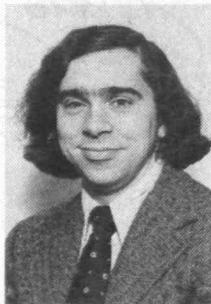
One of Suh's first official acts was to announce the appointment of Professor

Borivoje B. Mikic, ScD '67, noted for his pioneering contributions to heat transfer and engineering education, as associate head of the Department of Mechanical Engineering, effective July 1.

Suh noted that Mikic, a faculty member since 1966, has extensive knowledge of the workings of the department and the Institute and his experience as house master of 500 Memorial Drive gives him a thorough understanding of the needs of students. The department has not had an associate head in recent years. □

Bates Director Moniz Named Physics Head

Professor Ernest J. Moniz, director of the Bates Linear Accelerator Center since 1983, has been named head of the Department of Physics. A theoretical nuclear physicist, Moniz has gained wide recognition for his frontier work on the interaction of pions with nuclei. Pions are short-lived particles primarily responsible for the nuclear force. He has been instrumental in developing what is widely considered to be the fundamental description of pion-nuclei interactions.



Ernest Moniz

His appointment as department head was announced by Dean of Science Robert J. Birgeneau, who was head of physics

when he was named dean earlier this year. In making the announcement, Birgeneau said that Moniz combines outstanding research accomplishments with an excellent record of administration at Bates and a deep interest in education. Moniz was enthusiastically recommended by the Physics Head Advisory Committee chaired by Professor Thomas J. Greytak, '62, Birgeneau said.

At Bates, Moniz has helped guide the development of the laboratory's research program toward coincidence experiments and fundamental measurements of the electromagnetic structure of "elementary" strongly interacting systems, both nuclei and their constituent particles. The laboratory, which serves the national community, also embarked on a major upgrade—the construction of a "stretcher/storage ring" 200 meters in circumference. The facility will produce high-intensity continuous electron beams, thereby providing unique research opportunities starting next year.

Moniz, 46, received a BS in physics from Boston College in 1966 and a PhD in theoretical physics in 1971 from Stanford University. He joined the MIT faculty in 1973 after two years as an NSF postdoctoral fellow at the Centre d'Etudes Nucleaires de Saclay and the University of Pennsylvania.

The MIT Physics Department is one of the largest in the world and its graduate program is consistently ranked among the top five in the nation. Approximately 90 full-time faculty members teach the 250 undergraduate and 300 graduate students. The department provides education in all areas of both theoretical and experimental physics, including astrophysics, nuclear and particle physics, and atomic, plasma, and condensed-matter physics. □

MIT High School Program Keeps Bearing New Fruit

By Susanne Fairclough

Since it was launched in 1989 by Professor of Materials Science and Engineering Ronald Latanision, MIT's showcase Science and Engineering Program for High School Teachers has brought more than 150 secondary teachers to MIT, and through them it has had an impact on the science education of several thousand high school students. But as it continues to attract national attention and inspire like-minded projects, many of them among MIT alumni/ae groups, the program's role in the battle for science literacy is even larger than those numbers suggest.

"MIT is invigorating teachers with a shot of educational adrenaline, and we can pass that on to our students," says Lou Salvio, an earth science and biology teacher in West Hartford, Conn., one of the earliest participants. Salvio's glowing reports led two more teachers from his high school to enroll in the program in 1990.

The summer program began as one-day tours of the MIT Materials Processing Center when Latanision was its director. When the program hit its stride, it was a full week—the days filled with presentations by MIT faculty and researchers from many disciplines, and the evenings devoted to free-wheeling discussions or invited speakers from industry. Participants found food for thought everywhere.

It was music to the ears of Perry Kimple, a geology teacher and district cur-

riculum specialist from the state of Washington, when executives from Raytheon and Chrysler said that employers are seeking individuals with the ability to communicate, solve problems, and work independently. In Kimple's experience, the teaching strategies that develop those skills are also the

our society attaches to the teaching profession. College students are not stupid, Latanision said, they see by the salary numbers that society values law and medicine much more than science research, and they see that teaching is at the bottom of the ladder. The group agreed that the shortage of science



Teachers examine an aircraft engine blade at this summer's MIT Science and Engineering Program for High School Teachers.

When Program Director Ron Latanision tutored two 6th graders in his hometown, the kids created The Adventures of Superconductor Sam.

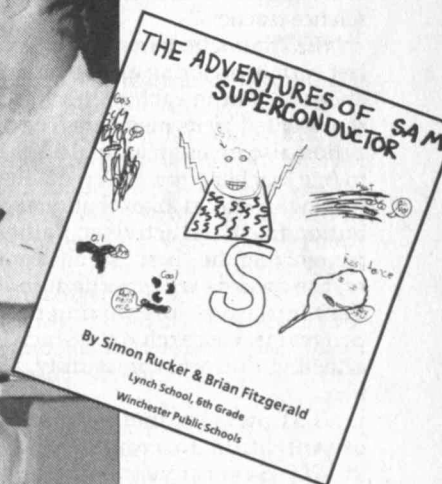
strategies that motivate students and keep them interested in science.

One of the evening sessions focused on the features of U.S. education the teachers would change if they could. At the top of everybody's list was the value

teachers will remain intractable until teachers are respected more and rewarded better.

Spinoffs: Improving on Success

Bruce Knox, director of the Material Resource Laboratory at Penn State, attended Latanision's first program in '89. Knox was inspired to initiate his own pilot program a year later, bringing an area teacher into his own lab as a summer research assistant and also sending the teacher to MIT for the one-week program. It was a week of broad introductions in Cambridge and the rest of the summer spent working in depth



back in Pennsylvania. "Using instrumentation, having tests come out the way he or she thinks they ought to, [the teacher] really sees how science proceeds," Knox said.

John Thompson, a physics and general science teacher in the community of State College, Pa., was the first teacher to go through Knox's program. Thompson is now collaborating with a chemistry teacher at his high school to reproduce with their students some of the experiments he worked on at Penn State. Specifically, they are trying to process fly ash, a by-product of coke production, into a slurry useful in reducing the acid drainage from abandoned coal mines. The pilot went so well that Knox is hoping to support two high school teachers and two elementary teachers for the combined MIT/Penn State program.

Another spinoff of the MIT summer program is the New England Science Teachers Association (NEST), whose present co-chairs are Latanision and Salvio. Founded by teachers participating in the 1989 program, NEST has a well-established newsletter that describes experiments, lists useful publications and announcements, and reports on activities of interest to science teachers.

NEST launched an awards program last spring, honoring an outstanding science student in each of the 90 schools represented by its members. The organization also gives an annual \$500 award to one teacher from each New England state who makes an exceptional contribution to citizen activism. Rather than recognizing the "best" student or teacher, the awards will spotlight independent initiative—organizing recycling programs, research on science issues affecting the local community, and the like.

NEST owes its funding as well as its organization to connections made at MIT. Several years ago, alumnus Arthur Gelb, ScD '61, approached MIT Treasurer and Vice-President for Development Glen Strehle, '61, looking for programs in which MIT was helping K-12 students to focus on science and technology. As a youth, Gelb was able to get one foot on the educational ladder by attending City College of New York for free, and he subsequently attended Harvard and MIT. At a critical point in his educational career, he needed guidance, and felt it wasn't forthcoming. Now that he heads TASC, a successful, high-tech, professional and technical services firm in areas such as communications, defense, and weather data, Gelb wanted to put some resources into providing that kind of guidance to

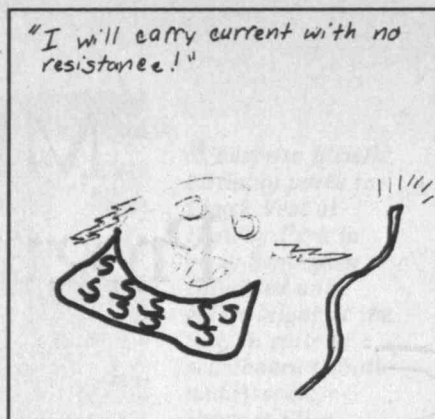
today's young people. "Kids are puzzled about how to decode the world," Gelb said. So he and his company made a grant of \$10,000 per year for five years to NEST, whose efforts, he believes, will "help them find a way through that maze."

A Prophet With Honor in His Own Backyard

Ron Latanision is a science activist for all seasons, demonstrating that action can be modest and local as well as high-powered and regional. At his son's high school graduation in Winchester, Mass., Latanision complained to his wife that of the 60 awards announced at the ceremony, only a handful recognized achievement in science or math. "Well, if you don't like it, do something about it," she challenged him. So he did.

With fellow Winchester resident Mark Wrighton, now MIT's provost, Latanision organized a committee of local MIT alumni, who raised an \$11,000 fund for the high school science department to spend on a public, science-related event, a guest lecturer, or an award. The target donors were originally some 300 MIT alumni/ae living in Winchester, but organizers later took the fund-raising community wide.

Latanision didn't stop there. When a Winchester sixth-grade teacher told him that the only advanced project for which she had not been able to find a mentor was in science, (you guessed it) he agreed to help. Latanision spent Friday afternoons helping two sixth-graders produce that most effective of



A Role for the Alumni/ae Association

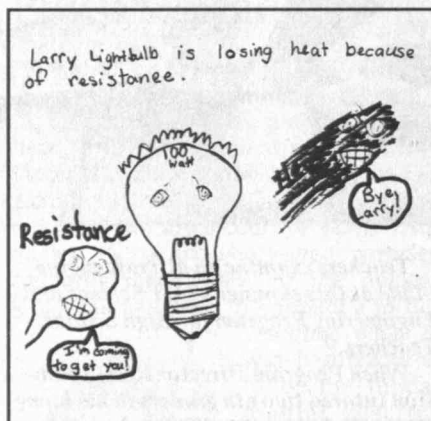
In the fall of 1990, Latanision and Chris Matthew, '43, then president of the Alumni/ae Association, urged the participants in the Alumni/ae Leadership Conference to go back to their clubs and get involved in science literacy. Later that year, the "dynamic duo" took their message on the road. They spoke about a variety of ways that MIT grads and clubs could make a difference.

For example, MIT covers room and board and program costs for the Science and Engineering Program for High School Teachers; if MIT clubs were to offer to cover transportation costs for one or more local teachers, that would open up the program to educators outside New England. Latanision sees that kind of initiative as a good short-term measure. In the long-term, he hopes other universities will set up programs to serve their regions, and he has offered to help organize "clones."

Al Bottoms, SM '62, vice-president of the MIT Club of Palm Beach, Fla., is promoting duplicates of the MIT program at the Florida Institute of Technology, the University of Central Florida, and the University of Virginia. A key aspect of his initiative is trying to persuade Florida high-tech firms and Epcot Center that by providing seed money for a teachers' program, industry could contribute to a skilled future workforce.

"People see immediately what Latanision is driving at; where it falls apart is lack of funding," says Bottoms, who estimates that a Florida pilot of the summer science and engineering program would require about \$60,000 for stipends and overhead. This is roughly the annual cost of the MIT program, which was endowed by a Carnegie Foundation grant, alumni/ae support, and MIT discretionary funds.

Bottoms was not the only member of the MIT Club of Palm Beach who reacted with enthusiasm to Latanision's message. Elda Chisholm, '49, invited him to



teaching tools for the young—a comic book—on superconductivity.

If each MIT faculty member, alumnus, and alumna would "adopt a kid," says Latanision, the effect would be tremendous. "When people are asked how they chose their profession, they often point to one pivotal experience in which a teacher or friend helped them."

visit Palm Beach Garden High School, where she has been teaching for 10 years. "It was a wonderful lift to the teachers, a confidence builder," she reports. Student apathy and daily class loads of 150 students can wear teachers down, Chisholm says. A show of interest from a college professor with some good ideas, and a chance to discuss problems with other teachers, can bring a real infusion of energy.

Until hit by the threat of massive layoffs among Florida teachers, two teachers from Palm Beach Garden High were planning to attend last summer's program at MIT, and Chisholm and her colleagues were looking into an Eisenhower Grant for Teacher Enhancement in Science. Chisholm is hopeful that the situation will stabilize before teachers lose the momentum generated by Latanision's visit.

Equally fired up by a visit from Latanision and Matthew, the MIT Club of Northern California formed a Group on Science Literacy. According to Chair John Cooper, '74, the group decided to launch small, grassroots programs that would enable it to "stay away from the 'f' word—funding." They distributed a questionnaire with the club newsletter, and received some 55 alumni/ae responses favoring tutoring and mentoring as the activities of choice.

Cooper then enlisted "mentor coordinators"—one of whom is Elda Chisholm's son, John Chisholm, '75. The coordinators contact schools to identify potential student participants and teachers and counsellors willing to work with mentors. The coordinators match students with mentors, then loosely monitor the process. Mentors might help a student master the regular curriculum, introduce advanced topics, or consult on a science fair project. The response has been, in some cases, overwhelming. One school had 70 students teachers wanted to enroll in the program, but only one mentor was available.

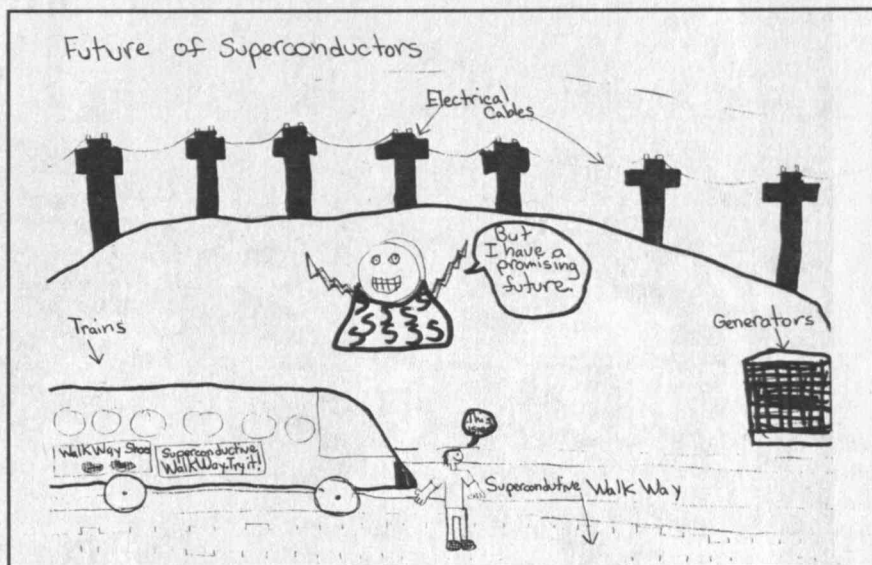
The Northern California Science Literacy Group is also setting up a volunteer program, based on the 13-year-old AMITA High School Visiting Program, that will encourage female students below

the ninth grade to think about science- or technology-based careers.

Members of the MIT Club of Southern California made a conscious effort to involve people from outside the MIT alumni/ae body in their science literacy activities. Graduates from other area universities were invited to a meeting last January, and club events coordinator Melinda Skaar, SM '87, found that most of those who turned out were

science, and they have few resources. As a result, many kids are turned off by the time they start high school. Some alumni/ae are looking around for models of effective intervention at the elementary level.

Cal Tech, for example, has several projects that focus on the early grades, including a science kit of inexpensive, readily available materials for elementary teachers. In one experiment in the



already involved in science education in one way or another. For example, many alumnae were participating in an MIT/Cal Tech collaboration called Open Options. Also patterned on the AMITA High School Visiting Program, Open Options sends women in technical careers to speak to female and minority students in their sophomore years. The students are urged to continue studying math and science to optimize their educational and career opportunities.

Skaar duplicated Cooper's questionnaire to identify other volunteer interests among her constituents, and is in the process of organizing a high school mentor program in the Los Angeles area.

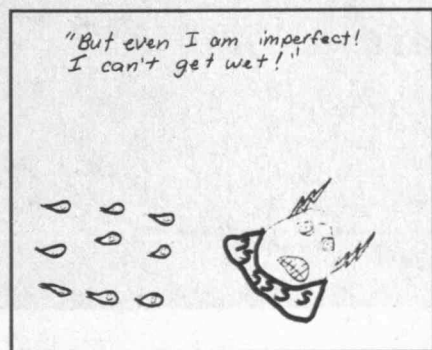
In other developments on the West Coast, the MIT Club of Puget Sound in Seattle used Latanision's visit as the catalyst for a panel that also featured Boeing's Kathy Nepiean, who spoke about the company's extensive education support programs, and Larry Swift, director of the Washington School Board Advisory Group. Kevin Moschetti, '89, the club president and event organizer, said that following the panel, 20 alumni/ae volunteered for mentoring and tutoring.

The Seattle panel emphasized a point that's been heard other places with depressing regularity: elementary teachers usually lack the background to teach

kit, the children are instructed to reshape a clay ball into a form that will float. Intrigued, they try various strategies until they come up with a hull shape. The kit includes tile chips for a second experiment: weighting the clay boat to determine how many chips it will support when floating on salt water, fresh water, and other fluids.

In a study of Cal Tech's outreach program, students were asked if they wanted to study science in high school. Eighty-five percent said yes. In the control group who had not been exposed to the Cal Tech program, an equally large group opted against studying any more science. Given Cal Tech's success with elementary grades and MIT's track record with high school teachers, Chris Matthew thinks there may be grounds for some fruitful collaboration.

Ideas such as Matthew's are not only surfacing with increasing frequency among alumni/ae, they are rising higher on the Institute list of priorities as well. At the Alumni/ae Leadership Conference in September (which will be reported in more detail in the January *Technology Review*), President Charles Vest announced that as one response to an Institute committee report, Ron Latanision has been named chair of MIT's new Council on Primary and Secondary Education. □





Building 20

The Procreative Eyesore



By Simson Garfinkel, '87

It's an eyesore with a distinguished past and an uncertain future. It's a 48-year-old monstrosity built of plywood, cinder block, and engineers' dreams. It's been the focal point for tales of zaniness and creativity going back more than a generation.

"It's the best building in the place," says President Emeritus Jerome Wiesner, who worked there for more than a decade.

It's Building 20, a three-story, 200,000-square-foot shack built soon after the United States entered World War II. Always intended as a temporary structure, the building evolved through a combination of accident, fate, and providence into a nest of creativity that has few equals in the annals of the Institute.

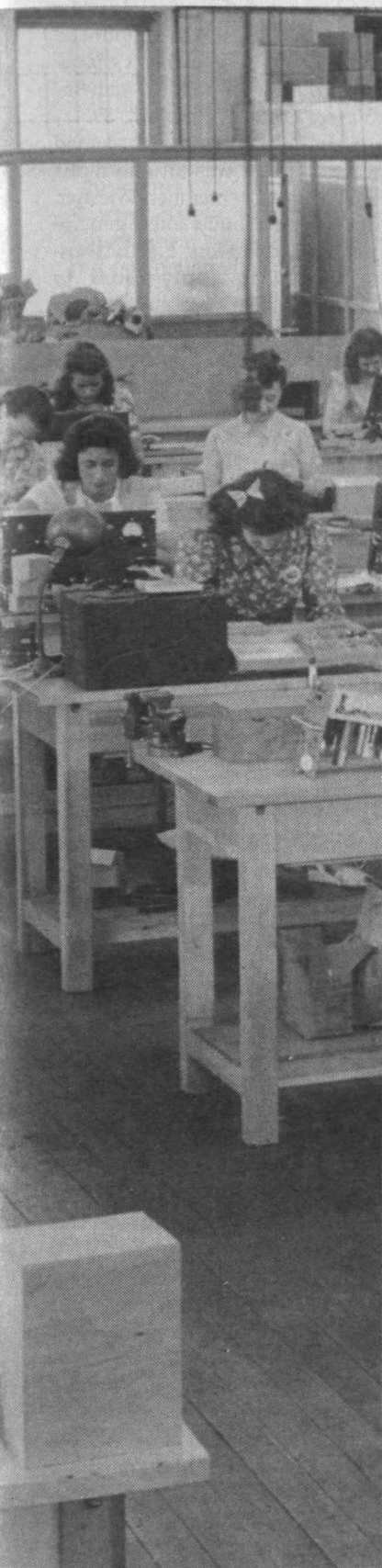
Building 20 began life as the home of the Radiation Laboratory, where ultimately 4,000 staff members designed, built, and tested radar systems that turned the tide for the Allies in the late years of World War II. This Model Shop, for instance, was a miniature factory where each worker built a complete unit.

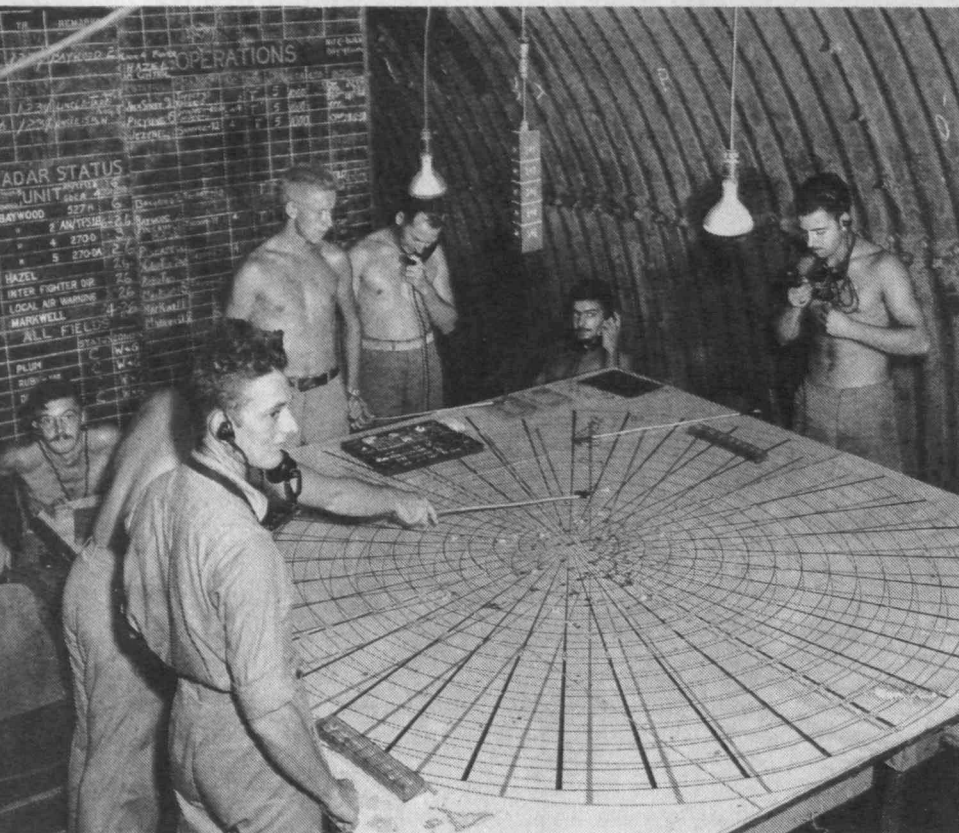
tect enemy planes. Four months later, shrouded in secrecy, the MIT Radiation Laboratory set up shop in Building 4. Military RADAR was about to be invented.

The first thing the new laboratory needed was staff. An MIT-hosted physics conference in the fall provided fertile ground. Documents at the MIT Museum tell how the attendees at that 1940 conference were surprised to find that the majority of the papers offered were on the subject of microwave radiation. During the conference, a series of interviews were conducted behind closed doors, and by the end of the week, a cadre of scientists was in place.

The lab quickly outgrew its space in Building 4 and expanded into a three-story tar-paper shack hastily built atop Building 6. Soon other temporary structures started popping up like mushrooms: wooden huts at the west end of campus housed scientists and graduate students; new labs in Buildings 22 and 24 sprung up alongside Vassar Street.

But the ad hoc bits and pieces were not adequate for the more than 1,500 people working for the Radiation Lab by 1942. That spring, physicist A.J. Allen, the first head of Building and Grounds for the project, called Don Whiston, '32, an architect at McCreery and Theriault Architects. Before the end of the day, Allen said, he needed a list of building specifications and preliminary plans for a 200,000-square-foot building. Whiston came through, and Building 20, at 18 Vassar Street, was underway.





Much of the information coming into the communication hut in the Pacific theater (top) was radioed in by the operators of ground-based and airborne radar designed at Rad Lab. The trucks backed up to Building 20 in August 1944 were loading on the first operational microwave early warning (MEW) radar system—all 66-1/2 tons of it—for shipment to England. According to one contemporary report, "One of these sets proved so effective in directing the planes fighting buzz bombs that only Prime Minister Churchill was able to pry it loose from the RAF on the eve of D-Day to send it to Normandy to control General Patton's tactical air support."

Building 20 is really six buildings, each three stories high with no basement. Each section rests on huge wooden beams bolted in place. The rooms were large by MIT standards, but otherwise working in the building was no picnic. It was cold in the winter, oppressive in the summer. The roof leaked. The windows never fit properly. Dust from the construction, then dirt from the wood of the building itself, was everywhere.

The building's roof was covered with gypsum planks, but even so, it was in clear violation of Cambridge building codes, which prohibited wooden buildings in that industrial East Cambridge neighborhood. The only way that MIT could get a building permit at all was by promising that the building would be a temporary structure, to be torn down when it was no longer needed.

By the war's end, more than 4,000 people were working for the Rad Lab, and the U.S. military had pumped in more than \$2 billion. Historians looking back described it as "a university in a pressure cooker"; during the Lab's five-year tenure, microwave electronics advanced 25 years.

Engineers perfected the magnetron as well as the associated circuits needed to turn radar from a laboratory curiosity into a war-fighting tool. The Lab developed radars for navigation, weather monitoring, detecting incoming enemy aircraft, direct-

ing anti-aircraft guns, and locating enemy U-boats.

The Radiation Laboratory's charter lasted only until the end of the war. "Just like with the senior class, it was announced that people would be available. Companies came around here to hire," remembers Professor Louis D. Smullin, '39.

But to many, breaking up the lab seemed like a waste. "There was an enormous pent-up set of ideas" remembers Wiesner. Physicists wanted to build a new generation of particle accelerators. Electrical engineers wanted to apply radar to communications. Everybody wanted to explore the promise of computers. The military also wanted to see electronics research at MIT continue. Mostly, says Wiesner, they didn't want to shut down a laboratory with a proven track record that might be needed in some future war effort.

And so the Research Laboratory Electronics (RLE) was born. Where to put it? "People were hired right after the war—people like me. We had to have a place to work. We had to have a place to put the students," says Wiesner, who later served as RLE's director. "It would have taken two to three years to build new buildings, and we would have had to raise the money."

With space at the Institute always at a premium, there was only one possibility: the "temporary" Building 20. James R. Killian, Jr., '26, assistant to President Karl Taylor Compton, negotiated with both the U.S. government and the City of Cambridge to transfer ownership of Building 20 to the Institute.

Saddled with the dusty, dingy, poorly ventilated wooden structure, the Research Laboratory for Electronics thrived. It was the Institute's first interdepartmental lab, combining electronics, physics, nuclear science, and acoustics. And while RLE's mix of the best and brightest electronics experts in the world was surely responsible for the lab's success, the building itself was a player as well.

"I think that a lot of things were better because of Building 20," says Wiesner. "You had ample space: a little more than you needed, rather than a little less, which is the normal situation." Best of all, Building 20 was made out of wood. It's a feature that many of the building's occupants have commented on. "You could do anything you wanted within your own confines," says Professor Emeritus Jerome Lettvin, who worked in electronics and physiology. "You could put up partitions, take them down, rewire anything you wanted to."

In 1952 Professor Jerrold Zacharias knocked out two floors of the building to make room for a three-story metal column that became the world's first atomic clock. Professor Walter Rosenblith took out the floors and walls in one lab and made a floating room: Rosenblith was working with hearing and vision and had to measure very small signals without any chance of vibration.

In another part of the building, RLE constructed an entire room out of mu-metal, a substance impervious to electronic noise and magnetic fields. "To get that damn thing in, they had to practically dismantle the corridor," remembers Lettvin. The room was rebuilt around the mu-metal cage, which is still there today.

In one of Building 20's two garages, a group of physicists built a linear accelerator driven by a Van de Graaff generator and microwave electronics. At the time the 17-million-volt accelerator was the most powerful in the world. Once again, Building 20's flexibility came in handy—this time making it easy to construct a concrete-and-lead vault for radiation shielding. "It was just the norm," explains Wiesner. "The whole thing was made of plywood. If you didn't like what you had, you just changed it."

The laboratory was extremely well funded, thanks to a \$600,000 annual grant from the Army, Air Force, and Office of Naval Research (ONR). The grant was incredibly open-ended, chartering RLE to "do research in electronics," recalls Wiesner. Scientists at RLE studied control theory, dynamics, cybernetics, cosmic rays, and acoustics, as well as electronics, physics, and nuclear science. The PDP-1, the first transistor-operated computer, was designed in Building 20, as were some of the very first electrocardiograph machines.

When Smullin set up his lab to study microwave tubes, his office mate was Institute Professor Noam Chomsky, then a newcomer to the faculty who was studying language as part of RLE's effort to build computers that could automatically translate natural language.

When the lab wanted to set up a section to explore the biology of the brain, Wiesner called the RLE's contract officer, Emanuel Piore, at ONR: "I said, 'Is it okay to do neurophysiology?' And he said, 'Are there any electrons involved?'" There were, and the section on neurophysiology was approved.

"Ah, Building 20!" sighs Jerry Lettvin, who worked in the plywood palace for



more than 30 years before "retiring" to Rutgers. "You might regard it as the womb of the Institute," Lettvin says. "It is kind of messy, but by God it is procreative!"

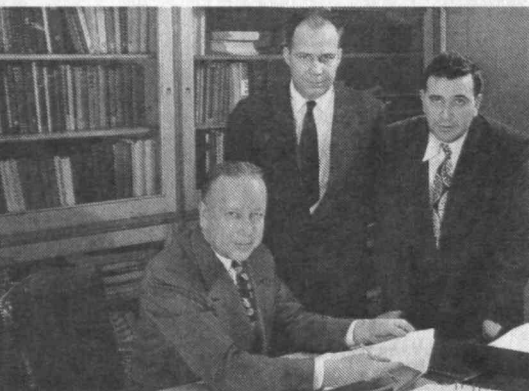
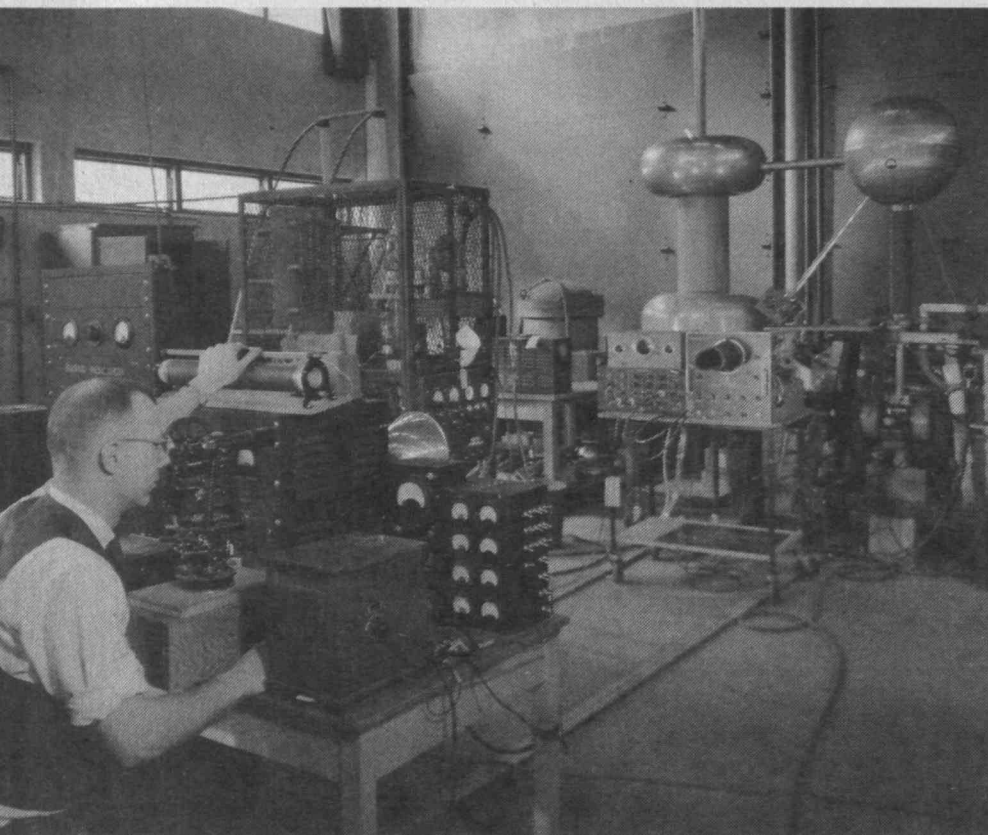
Bolt, Beranek and Newman, the highly successful acoustic and computer consulting firm, got its start in Building 20's Wing F, the home of the MIT Acoustics Laboratory.

So did Bose speakers. In the spring of 1956, Professor Amar Bose, '51, was sitting down to write up his doctoral dissertation on mathematical communications theory. "Relative to doing the work, [writing the thesis] was a boring task, so I decided to buy a hi-fi system," Bose recalls. After spending nine years at MIT, Bose thought he knew everything about amplifiers and sound reproduction, so he went to a number of stores, looked at printed sheets of specifications, and bought the "right" system. "I didn't even bother listening to it, I was so confident that I knew the technology."

But when Bose got the hi-fi home and set it up, it sounded terrible. He graduated that June and spent the summer fiddling with speakers in the old Acoustics Lab, trying to figure out why they sounded so bad. He returned a year later to teach statistical communications, but on the side he pursued his own research in the anechoic chamber. "I can remember so many nights there, not getting out until



Technicians were the mainstay of the Laboratory," said the caption for the top photo when it ran in an illustrated history of Rad Lab. Well, of course. P.H. Bonnet is shown testing magnetrons. Our best guess is that the lower photo is a spoof inspired by Prof. George Harvey's zealous salvaging of what Prof. Emeritus Louis Smullin described as "a gold mine of microwave equipment and instruments," left behind by Rad Lab. Harvey tagged everything in sight, "property of RLE."



In one of Bldg. 20's two garages, a group of physicists built a linear accelerator driven by a Van de Graaff generator and microwave electronics (top, in a 1947 photo). At the time, the 17-million-volt accelerator was the most powerful in the world. The 1949 photo of (l. to r.) Jay Stratton, '23, Albert Hill, and Jerry Wiesner records a lot of Building 20 leadership: the men served in turn, in the order named, as the first three directors of the Research Laboratory of Electronics.

two, three, or perhaps eight," Bose recalls.

Then one day in 1959, Jerry Wiesner saw a strange object in Bose's office: a wedge-shaped contraption with 22 loudspeakers attached. "What does this have to do with statistical communications theory?" he asked. Nothing, of course, but Bose went on to tell Wiesner the results of his clandestine research project: everything in the textbooks about designing loudspeakers was wrong. Bose was trying to find out what was right. With Wiesner's blessing, the loudspeaker research project became official; five years later, with a handful of patents, Bose started his own company to market speakers.

In 1957, RLE started moving out of Building 20 and into more permanent surroundings. Into the space left behind moved a kaleidoscope of different groups, from the Campus Patrol to MIT-Wellesley Upward Bound, a program for disadvantaged high school students. The documentary filmmaker Richard Leacock was based in Building 20, and Doc Edgerton, '27, did basic work in sonar and underwater imaging there. Many of the groups that came to Building 20 "moved there under protest," Lettvin recalls. "After they got there, you couldn't get them out."

Building 20 became a center for MIT's education reform efforts. In the 1960s, it housed Professor Jerrold Zacharias' Phys-

ical Science Study Committee and Science Teaching Center, which developed a physics curriculum used by a generation of U.S. high school students. The Undergraduate Research Opportunities Program (UROP), which made pedagogical history by bringing undergraduates into research laboratories, set up shop in there in 1969 and has stayed in Building 20 ever since.

In the mid-1960s, Physical Plant installed a radio paging system for the Institute's janitors. "I used to read EEGs, and Building 20 is made of wood" recounts Steven Burns, technical director of the Harvard-MIT Health Science Program. "Every time they called a janitor, we recorded it on our EEG." Having serious doubts about the need to have radio-dispatched janitors, Burns and his compatriots procured a crystal for the same frequency used by Physical Plant and made a recording of the paging system's call tones. "We figured that jamming wouldn't work, but that they would get pissed off with false alarms," Burns says, with classic Building 20-bred irreverence.

Despite being the home of Army, Navy, and Air Force ROTC, Building 20 never received a bomb threat during the student unrest of the late '60s. "All of the people who were against the war were housed there," says Warren Seamans. "To bomb Lettvin's or Chomsky's office didn't make much sense."

Linguistics Professor Morris Halle scoffs at any attempts to romanticize Building 20. "The most important fact is that it was undervalued space," he says. Because the space was so cheap, he believes the linguistics program was allocated far more turf at MIT than it would have had at any other university.

When Halle came to MIT to set up the program, linguistics was a solitary discipline: graduate students would see their professors and classmates infrequently, spending most of their time in the library. Roomy quarters in Building 20 meant being able to revise the curriculum completely, emphasizing group discussion and work. "In order to have research as a social activity, you need space where you do it," he says, and the research they did revolutionized the field.

A 1979 survey of Building 20's occupants found mixed feelings about their accommodations. Researchers liked the fact that the wooden building was spacious, informal, intellectually stimulating, and, most

important, "mutable." But people complained about temperature problems, dirt, and isolation. One professor wrote about being "put in storage" in Building 20; another said that the Building 20 assignment was a form of "punishment" by the administration.

It's not hard to understand the divergence of views. "Building 20 is great because it has no pretenses at all," says Gill Pratt, a research assistant at the Laboratory for Computer Science who spent more than a decade in Building 20. It appeals to people who don't care about appearances. He says the denizens of Building 20 "cooperate and work because of joy. Nowhere[else] can you find an atmosphere where none of the other trappings of academia exist."

Building 20 is showing its age. Every few years, physical plant workers have to tighten the bolts on the beams holding the building together, and a window or two gets blown out by hard winter winds. Of course, the fact that it is not only standing but useful is pretty impressive. It's the only surviving member of its class of WW II buildings.

Some of Bldg. 20's contemporaries have burned: a wooden cottage on the west end of campus went up in flames, taking with it the only copy of one graduate student's PhD thesis. Most of the other buildings were torn down to make room for more permanent structures.

"Everybody says that Building 20 is a fire trap. Obviously it isn't, because it is still here," says Smullin. In the 1970s, the city of Cambridge began pressuring MIT to have the building demolished. "The city used to complain that we had overstayed our leave," says Wiesner. But MIT was reluctant to tear it down because of the enormous amount of functional office space that it represented. "Nowadays, a building with 200,000 square feet is an \$80 million building, so it is not an easy thing to replace," he says, smiling.

The pressing problem with Building 20 is not fire but asbestos: the building is filled with it. It turns out that Building 20's famed plywood walls are really a composite material impregnated with asbestos fibers, which have been implicated in a variety of lung diseases. As a result, what some people have called Building 20's best feature—that it is easily reconfigured—is now gone.

"We broke a wall here some years ago," remembers Morris Halle. "They had to

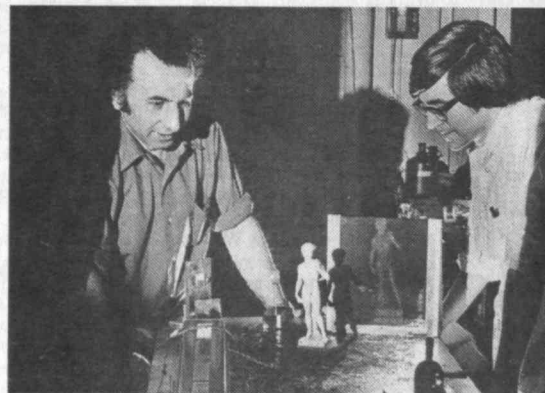
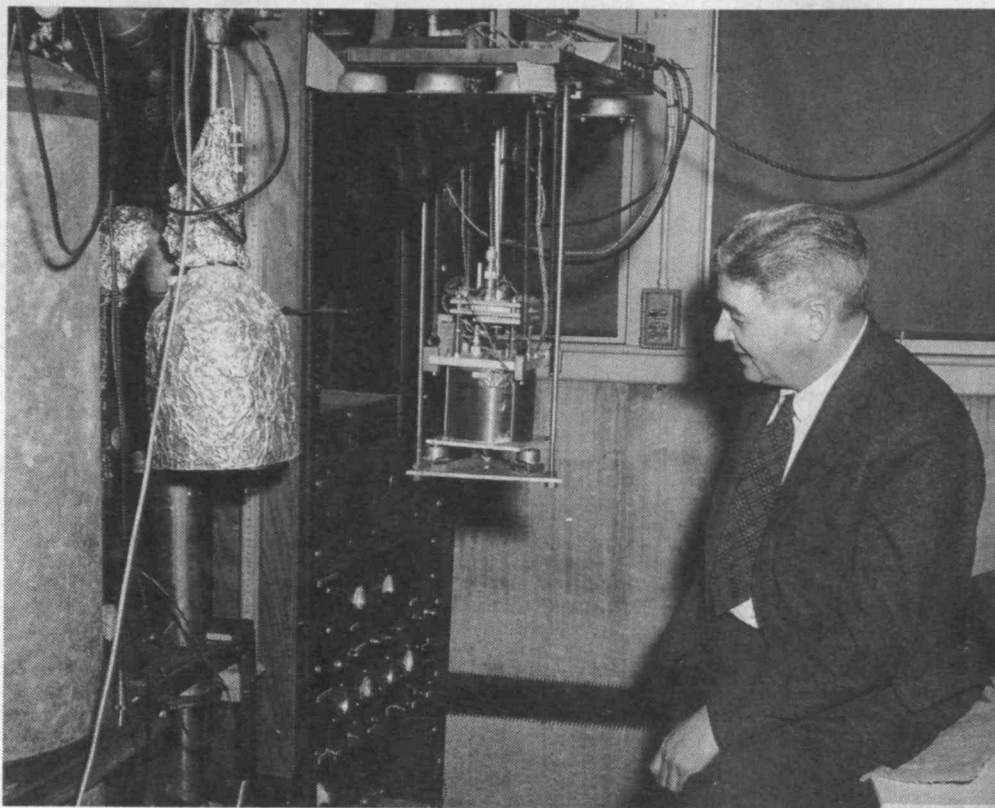
bring in fans. We weren't permitted back in until they cleared the area. They took it very seriously." Another time, when a workman mistakenly drilled through a wall to pull a wire, the area had to be cleared for five days until it was decontaminated.

"The building will ultimately be replaced as part of the overall campus plan," says Robert Simha, director of MIT's Planning Office. The plywood palace will probably come down in sections to make room for modern steel, concrete, and glass constructions with six or eight stories. But, concedes Simha, "I would not hold my breath."

"The reality is that Building 20 is fully occupied and we can't do anything with it before significant pieces are relocated," says Simha. Right now his office is focusing on the construction of the new biology building, Building 68. Once that is completed, groups moving into Building 68 will free up labs and offices in other parts of campus. At that point, parts of Building 20 might start getting cleared out.

The trick will be to keep another round of entrepreneurial technologists from moving in. □

Simson Garfinkel, '87, is an editor at Next World magazine. He writes often on science for the Christian Science Monitor, and his book on security for UNIX systems was published by O'Reilly & Associates in August.



The charm of Bldg. 20 has been its mutability: in 1952, Jerrold Zacharias knocked out two floors of the building to make room for a three-story metal column that became the first atomic clock (top). And the building is big, offering lots of cheap space for projects like UROP, a daring experiment at the time of its founding. Jeffrey Shooker (bottom right) was a freshman when UROP gave him the chance to work on holograms in a laser lab.



17

It is my sad duty to report the passing of two New Jersey classmates—one, three years ago; the second, last July.

November 1, 1988, one of our civil engineering graduates, **Thomas E. Hannah**, died eight days before his 94th birthday. Because he was blind, he had lived with his daughter and son-in-law for seven years.

A. Raymond (Ray) Brooks died July 17. Having known Ray for decades and having been a regular telephone correspondent with him for several years, I am tempted to include in these notes an extensive biography of his World War I exploits, his volunteer activities on behalf of MIT, his multitude of contacts with today's world of aviation and his devoted friends—both notable and not so well known. But much of this has been covered by me and my predecessors in your class notes, more recently in a special article in *Technology Review* (May/June 1991, p. MIT 15). Let me know if you would like a copy of the latter, or the *New York Times* article showing Ray at 92 at the controls of a "breezie," which he flew at an air show in the Midwest. (A "breezie" is a small plane in which the pilot sits out in front in the open air.)

You can tell your grandchildren and great-grandchildren of your classmate, whose World War I Spad XIII open cockpit fighter plane may be seen in Washington at the Smithsonian Air and Space Museum. His picture may well appear in World War I articles of the future, for I am told the Smithsonian alone has 19 different photographs of Ray in their archives.

Ray had been offered a gravesite in Arlington National Cemetery in Washington, but long ago chose to have his hometown, Framingham, Mass., as his final resting place.—**Don Severance**, acting secretary, 39 Hampshire Rd., Wellesley, MA 02181

18

Herb Lerner recently wrote to Reid Weedon, '41, from which we excerpt the following. "On television the other night I thought of MIT as I listened to the Boston Pops orchestra accompany the Coal Miner's Daughter singing 'You've Come A Long Way Baby.' Old people tend to look back a lot. I do it myself although my long-time motto has been, 'Hats off to the past and coats off to the future.' I'd like to give you, at random, a lesson in ancient history that many MIT graduates don't know about.

"You see, I was born in Cambridge in the last decade of the 19th century. As a boy, living on Dana Hill, I would sometimes stray down Massachusetts Avenue to the river and get into games of scrub football and the like on the precise spot now called Killian Court. That area was then called Cambridgeport because small ships and barges could navigate the Charles up to and beyond, I guess, the Western Avenue bridge. In big storms, the river would sometimes overflow its banks and inundate the lower port area as far up as Sidney Street and Lafayette Square.

"When it came time to go to college, my brother Harold, who was a student of naval ar-

chitecture at MIT, persuaded me to transfer my credits at Harvard and join him at MIT. He was the smart one; I couldn't have made it without him.

"The car fare to Boston in those days was five cents, and on the way to classes at the old Boston Tech on Boylston Street, I would pass the new MIT being built on the very same spot where I used to play football.

"In 1915 when time came to move to Cambridge, there was the problem of moving much sensitive scientific apparatus from the laboratories in the Walker Building on Boylston Street to Cambridge. I was one of a small group of students who were invited to transport the stuff instead of entrusting it to the regular moving people. Driving a big Peerless truck, I crossed the Harvard Bridge with my colleagues countless times during the vacation period in 1915. So in a manner of speaking, my 1918 classmates and I actually put MIT where it is today.

"Some day, of course, I'll be going back to Cambridge to retire for good, and by way of giving you a bit of amusement I enclose a sad poem of a Harvard man who was rejected by Saint Peter. Like the fictional character in that bit of poetic nonsense, I, too, own a spot of land on Mt. Auburn Street. But I hope by then that some quota system will be in effect, and that being MIT instead of Harvard, I'll get preferential status."—**Max Seltzer**, secretary, North Hill, Apt. B403, 865 Central Ave., Needham, MA 02192

19

In an earlier issue of the *Review*, I stated that our class had, I believed, 29 living members. Then I received a letter from **George Michelson**, who after reading our notes, expressed pride in our class for its longevity. I then recalled some advice by Charlie Clark who at one of his lectures to the assembled 1919 Class on physics said, "Don't ever prophesy unless you know."

We received word of two deaths—one on April 25, 1974, in Japan of **Uchichi Nabeshima** and the second of **Alan G. Richards** on January 25, 1991, in Arcadia, Calif. Many of you will recall Alan, who in our earlier years was assistant secretary of the Class of 1919. Advice of his death came from his wife, Virginia, in Arcadia. I hope to have more to tell you in a later issue.

The report of Mr. Nabeshima came from his grandson in Japan via the MIT Alumni/ae Association: he wrote to acknowledge a birthday card to his grandfather.

Speaking of class secretaries, at our reunion at the Belmont Country Club near Boston in 1939, **Gene Smoley** was elected secretary of our class with **Smoe McCreery** as his assistant. Gene did a bang-up job, and at his passing I came aboard to give it a try. In this connection, I have several copies of the pamphlet made available at our 25th Reunion entitled "25 Years After." It contains a record of the living members at the time and an "In Memorial" of the 47 classmates who had died. If interested, write me and I will mail whatever I have left.

Meantime, keep eating and breathing.—**W.O. Langille**, secretary, P.O. Box 144, Gladstone, NJ 07934, (908) 234-0690

20

Please send news for this column to: **Harold Bugbee**, secretary, 3 Rehabilitation Way, #313 Country Club Heights, Woburn, MA 01801

21

Today (as these notes are written) is August 10, and in two days your secretary will be 92 years old. Well, we are all in our 90s now. I will get a telephone call from **Cac Clarke** who is six months to the day younger than I.

We had two death notices this month: Mrs. **Leroy Hersum** of Toronto, Ontario, on October 10, 1990, and Professor **Roy J. Campbell** of Bath, Maine, on June 26, 1991. Roy Campbell received a master's degree in public health from Harvard College in 1921. He also attended MIT and the University of Chicago. He has a long teaching career at Tufts Medical and Dental Schools. He was a sub-master at the Barnstable High School and later appointed associate professor at Salem College in Winston Salem, N.C. He was known as "Mr. Chips" on the Salem campus.

Our condolences are extended to the families of these two people.—**Sumner Hayward**, secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel E. Lunden**, assistant secretary, 6205 Via Colinita, Ranchos Palos Verdes, CA 90274

22

70th Reunion

Sorry, no news from or about 1922ers. This seems to be perfectly normal from any group in which all are over 90. Two exceptions in our class are **James L. Guardo** (born June 22, 1902) and **Samuel Seegal** (born May 18, 1902). Reporting for myself, what do I do? Not much. Still drive the car, a '67 T-Bird, cut the grass now and then, take care of endless miscellaneous small household difficulties, remove the trash, wash the dishes, walk up and down stairs many times each day, and see the doctor and dentist as troubles real or imagined appear. No more golfing, sailing, bowling, or skating. Just on a gentle downhill slope, but Ruth and I hang in there. Hope to see you all in June 1992.

Professor **William A. Waldschmidt** died December 28, 1990, in Midland, Tex. . . . Dr. **Mortimer C. Bloom** died February 2, 1990, in England.—**Yardley Chittick**, secretary, Rt. 1, Box 390, Ossipee, NH 03864

23

Please send news for this column to: **Frederick O.A. Almquist**, secretary/treasurer, 63 Wells Farm Dr., Wethersfield, CT 06109

24

No news may be good news. Nonetheless, I have heard from no classmates this month. How is everything going with all of you? Yours truly just came back from an astonishing cruise to see the solar eclipse in Mazatlan. We went out to sea to

1900-1991

Horatio Bond



Horatio L. Bond, '23, who was the 60th president of the Alumni/ae Association in 1953-54, died at Cape Cod Hospital, Hyannis, on July 26; he was 90.

Bond, who graduated from MIT in business and engineering administration, was a specialist in fire safety. He joined the staff of the National Fire Protection Association, a cooperative sponsored by the fire insurance industry, in 1930 and was its chief engineer for 30 years starting in 1945. He retired in 1975 and at the time of his death was a resident of West Hyannisport.

Bond was secretary of his class for 25 years starting in 1928. He was a member of the Alumni/ae Fund Board in 1949-51, when he was also vice-president of the Alumni/ae Association. Following his year as president of the Alumni/ae Association, Bond was elected a term member of the MIT Corporation, on which he served from 1954 to 1959. □

be away from the clouds, and we had an excellent view of the eclipse, as well as the three planets all in a line. Such a thrill! We had lectures three times a day by physicists, astronomers and other intellectuals. We felt like we were with a lot of MIT graduates. We learned a lot.

By the time you read this I will be back from Oxford, England, where my daughter has been asked to a conference to give a paper on philosophy. Her mother is very proud.—**Katty Hereford**, secretary, Box 2597, Carmel, CA 93921; Col. **I. Henry Stern**, secretary, 2840 S. Ocean, #514, Palm Beach, FL 33480

25

A note from **Don Taber** reports that he and Billie are in good health and enjoying travel as the following quote proves. "In June my wife Billie and I had a wonderful trip to England on the *Queen Elizabeth 2*. We spent most of our time enjoying the superb food. In London we visited the Courtauld Institute Galleries in their new home. Magnificent—don't miss it when in London. A good musical to see is *5 Guys Named Moe*—the audience stood for seven curtain calls! We spent seven days in the Cotswold and York area—the

highlight was a visit to the home of the champion sheep dog handler in England. He took two young sheep dogs with him while he demonstrated his talent by rounding up 100 sheep in a 10-acre plot in 10 minutes. Then back to the USA on the Concord—top speed 1,320 miles per hour at 59,000 feet without a ripple on my cup of coffee!"

It is with sadness that the passing of **Paul R. Goldings** must be reported. Word of Paul's death on December 12, 1990, was supplied by his cousin, Arthur Kolotkin, MIT, '68. Like many classmates, Paul had not supplied us with word on his activities over the years. Most of his working days were spent in Flemington, N.J., where he was treasurer of the Flemington Lumber Co. for many years. He was later owner-partner of that company. At the time of his death, Paul was residing in Brooklyn, N.Y.—**F. Leroy (Doc) Foster**, secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

26

As these notes are being prepared (late July), your class secretary is in the hospital having suffered a stroke that has effectively left him unable to talk and write. He is expected to be in the Braintree (rehabilitation) Hospital for several weeks of recovery before returning to the Eventide retirement home. If you cannot reach Don at his usual phone number, you can call Eventide at (617) 472-8300 for an update report.

For the last year, I (Ron Frazier), a friend of Don's, have been assisting with the preparation of this column. One of his greatest loves being MIT and his job as class secretary, he asked that I make sure these notes were published. If you have any news for future publications, please write "Class Notes" on your envelope.

Don's files contained the following items. . . . Henry L. Maury, of Arlington, Va., reports that his father, **Jesse L. Maury**, whom he believes was a member of the first class of Sloan Fellows in 1931, died April 4, 1991. He lived a varied and productive life, raising five children and, in his last years, took care of his wife, Margaret, who is in failing health. Jesse worked as a mining engineer from 1928 until the 1960s (part-time). He also worked for the federal government during the 1930s and 1940s; ran his own manufacturing business from 1948 through 1968; passed the CPA exams on the first try in 1971; and worked as an accountant until two weeks before his death. He was very active in local politics, including eight years on the local sewer and water board and two years as its chairman. He is survived by his wife, all five children, seven grandchildren, and seven great-grandchildren.

Richard W. Sherman, 87, of Portland, Maine, died last June 5, after a short illness. He served for over 25 years as a civilian engineer with the U.S. Navy, stationed in New York, Connecticut, and Maine. During World War II, he worked at the Bath Iron Works. He was a summer resident of East Boothbay since childhood, and was a year-round resident there, on Meadow Cove Road, for many years after his retirement in the late 1960s. In recent years, he and his wife, Elizabeth, had traveled extensively in England, Scotland, Wales, and Ireland.

Reverdy Johnson, of Sarasota, Fla., reported to **Bob Dawes** that he would not be able to attend the 65th Reunion, noting that he had not recovered sufficiently from two operations in 1990. . . . **John Wills**, of Colorado Springs, called from his summer home in Colorado on June 26 to update Don on what he was doing. (Don didn't complete his notes on this item.)

A point of clarification: In the August/September *Review*, we mentioned some notes **Bob Dean** had written about **Fred Buenz**. It seems there was some confusion in the interpretation of those notes by some of our readers. We want to make it clear that Bob's eyes are still very good. He goes into his office every day, and he and his

wife, Ruth, are still living in their pond-side house. He does some watercolor painting and continues to create his metal sculptures, of which at least one was in a recent Boston Athenaeum show.

Your class secretary spent a week in June on Martha's Vineyard, where his family has two houses. He worked on the island as a clerk for a summer hotel four of the summers he was at Tech. Ron Frazier for **Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

27

65th Reunion

We regret to report the deaths of three classmates. **Charles F. Sweet** of Gettysburg, Pa., died on October 21, 1990. He retired in 1970 as chief engineer of the Ejector Division of Ingersoll Rand in New York City. Charley suffered cancer twice before 1987 and had survived with doctors' and hospitals' assistance. He took movies of our 10th, 20th, and 50th reunions and enjoyed his hobby of photography, making documentaries of weddings and social parties. His wife, Althea, to whom he was married for 60 years, survives him.

Julius Friedman of Lynbrook (Long Island), N.Y., died on May 25, 1991. In 1937, he started his own company, Merit Plastics, and has operated in the molded plastics field for a long time. He married Dorothy in 1929, and they were together for 62 years. A contribution was given to the Alumni/ae Fund by Maureen Beren of the Class of 1928 in him memory.

Larry Grew reported the death of **Winfred E. Dunklee** of Hamden, Conn., on July 25, 1991. He lived in Hamden since 1941 and retired in 1970 from Southern New England Telephone Co. He was an engineer with the transmission lines division and was a member of the Telephone Pioneers of America. He is survived by his wife, Helen, two daughters, six grandchildren, and three great-grandchildren.

Larry also reported that his health is okay but, having enjoyed marriage for 59 years, he gets "lonesome among plenty of people and activities" but is "beginning to catch on to being a widower."—**Joseph C. Burley**, secretary, Isle of Springs, ME 04549; **Lawrence E. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

28

It is unfortunate that as our class reunions approach the terminal point, news of classmates involves handicaps and deaths rather than activities and interests. Perhaps this issue of the *Review* is a case of no news being good news, as this month there are no losses to report, or for that matter news of activities either.

For the present and immediate future, there should be things concerning our coming 65th Reunion that we could all find of interest. It is a milestone that brings pride in our longevity and accomplishments. To continue the work of **Walter Smith**, I would like to compile an updated mailing list to assist class members in exchanging greetings. We have about 223 living members, which I intend to verify in time for reunion purposes.

One change of address to report: **Leon B. Locklin** is now at 553 Rock Springs Rd., NE, Rm. 687, Atlanta, GA 30324, (404) 350-1687.

Remember, our 65th Reunion in 1993 is right around the corner.—**Ernest H. Knight**, secretary, Box 98, Raymond, ME 04071, (207) 655-4231

29

Adrian N. Clark (wife Hope) of Woodbury, Conn., writes, "Thank you for your yearly birthday greetings. I enjoy reading your notes about our classmates. You are doing a good job. No bad news here; both Hope and I keep busy giving

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something back to those who need it. Say hi to our classmates." . . . The wife of our late classmate **Charles H. Campbell** of Hooksett, N.H., writes, "During the summer, we toured in our family car to see old friends. I am 86 years old. I have two children, six grandchildren, and seven great-grandchildren." . . . A note comes from the family of **Joseph D. Murphy**, who is confined at Barnes Extended Care in Clayton, Mo. Joe is struggling with Alzheimer's and has been living at Barnes for the past eight months. Letters and visits are appreciated. He was an eminent practicing architect. Joe recently lost his wife, Anna, who passed away on last May 27.

Harry E. Dickinson and wife Ruby of Rotonda West, Fla., write, "Our health is declining since January 1991. We have limited our activities, get to play bridge a few times a week, and manage my portfolio. I was lucky to be able to renew my Florida "safe-driver" license for six more years. Our granddaughter just completed her first year of college in California." . . . I have a note from Dorothy Newman, wife of **John D. Newman** of Deland, Fla.: "John lived to be 90 years old, and we were happily married for 63 years. We adopted two boys, one died when he was 27. The other one lives in New Jersey. We traveled a lot, as John was in the Army. I miss him tremendously." . . . **Rolf A. Zurwelle** (wife Polly) writes: "A recent letter from my old roommate, **Lawrence D. Luey**, tells me that his dear wife continues to be in good health. He enjoys golf and auto travel to visit their sons and soon will vacation in Southern Pines, S.C."

I received a pathetic letter from Isabel Horan, wife of **Laurence A. Horan** of North Chatham, Mass.: "It is with a broken heart that I report to you that my darling husband of 55 years is now in Liberty Commons Nursing home, located at 390 Orleans Ave., N. Chatham, MA 02650, since March 1991. I miss him terribly and wish he were living with me at home. The nursing home is very expensive and in two months his funds will be gone. Then they will take mine. Thank you for the Class of 1929 birthday greetings." . . . I regret to report the death of **Earl Hathaway Abbe** of Newbury, N.H., on May 19, 1991. He was appointed laboratory assistant at MIT from 1929 to 1930 and worked for Moore Drop Forging of Springfield until 1941. He worked for Springfield Armory as a metallurgist until his retirement. He was the widow of Martha (Jorgensen) Abbe, who died in 1984 after 52 years of married life. He leaves a daughter, Mrs. Louis Gallup of Sunapee, a son, Earl C. Abbe II of McLean, Va., five grandchildren, and three great-grandchildren.—**Karnig S. Dinjian**, secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364, (603) 926-5363

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As in prior years, the Lister family held its family reunion in New Hampshire in July. This year we stayed at Belknap Point on Lake Winnepesaukee. During the reunion, I managed to touch base with two of our classmates. One was **Reg Bisson**, a longtime Laconia resident who recommended a seafood restaurant in Laconia. We had a pleasant chat, and, at the time, Reg was engaged in building a birdhouse for one of his grandchildren.

Also, we visited Maryan and **Yicka Herbert** in Tuftonboro, a few miles north of the lake. The Herberts have a spacious and very attractive home on eight acres near a highway intersection known as Tuftonboro Corner. They are both excellent bridge players and apparently win quite a few of the local duplicate sessions. Since Louise and I enjoy bridge, we all played for about three hours. Needless to say, the Listers were decisively vanquished at the bridge table, but we enjoyed comparing notes on numerous trips we had taken.

After leaving the Herberts, we drove to Boston for a two-day visit at MIT where we had the opportunity to meet and chat with the new and impressive MIT president, Charles Vest, and also

provost Mark Wrighton.

Jack Latham is in the news again as the donor of more than \$1 million to the Norwich (Conn.) Free Academy, the secondary school from which he graduated in 1926. Jack and his gift are the subject of an extensive article in the June 25 *Norwich Bulletin*. Jack's four careers as Du Pont employee, chief engineer of Polaroid, vice-president of A.D. Little, and founder of Haemonetics, Inc., manufacturer of blood processing equipment, as well as his designation as N.E. Inventor of the Year, have been previously mentioned in this column, but the newsclip from the *Bulletin* contains a number of other items of interest. His gift to NFA will be used to build a 33,000-square-foot addition to the library that will be named for Jack's father, Allen Latham, Sr., who was head of the NFA Physics Department for 18 years. Also Jack and Edwin Land, founder of Polaroid, were schoolmates at NFA. It further appears that Haemonetics equipment was used extensively during the Persian Gulf War. Col. Anthony J. Polk, director of the Department of Defense's Armed Services Blood Program, praised the company for rapidly providing supplies and training 40 military personnel to "deglycerolize" frozen red blood cells to treat Persian Gulf casualties.

We have notices concerning the deaths of two more classmates: **Kenneth Bucklin** on May 7, 1991, and **John DeLorenzo** in the latter part of June. My records indicate that, after graduating in Course VI, Ken went to work for RCA in Harrison, N.J., and continued at RCA until his retirement in 1969. At the time of his retirement, he was manager of receiving tube engineering and of commercial engineering. After retiring, he and his wife, Etta, moved to Ormond Beach, Fla., where he was living at the time of his death. He was a senior member of AIEE as well as a member of the QSO Radio Club and Amateur Radio Relay League and maintained his interest in amateur radio before and after his retirement. After the move to Ormond Beach, he became active in the local Kiwanis Club as director/editor of the newsletter, and secretary. In addition to Etta, he is survived by two daughters, Brenda Manning of Hopkinton, Mass., and Jean Shiels of Dover, Del. . . . **John DeLorenzo** was born in Italy in 1901 and came to this country as a child. It is my recollection that he was a cousin of **Bart DeLorenzo**. John entered MIT with us in 1926 and elected Course X but dropped out before completing the course. He owned and operated a turkey farm in Duxbury, Mass., for many years. His wife, Anna, predeceased him, but he is survived by a son, two daughters, and six grandchildren.—**Gordon K. Lister**, secretary, 294-B Heritage Village, Southbury, CT 06488

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As those of us who went to the reunion know, **Ben Steverman** left early because of a medical appointment for an operation for cancer of the aorta, which was apparently quite successful. He was quite happy with the results of his appeal for class dues—73 replies totaling \$2,431, as of August. He gave me a note from **John R. Outt** who, though a graduate student in electrical engineering in 1931 (he graduated from the University of Colorado in 1930), apparently has adopted our class. John commented on being into high voltage with Parry Moon; the network analyzer with Samuel Caldwell; and Vannevar Bush's analog computer. John was completely taken aback when Harold Edgerton's microsecond flash gave a picture of a high-speed rotor (1,000 RPM) he had "put through its paces" standing still! During World War II, he saw the evaluation of the relative abundance of isotopes of mercury and the helium leak detector, which were items essential to the subsequent plant at Oak Ridge, and to ICBMs, the anti-missiles, and all that followed. He flew to India in 1951 on a Constellation and assisted Sitram, Badkas, Subranian, and IGE in commencing a high-voltage lab at Bangalore,

Mysore State. He also added that he now has four great-grandchildren.

Philip Donely died at Williamsburg Landing last May 3. He retired from NASA in 1972 as chief of the Flight Research Division after 41 years of service. He was the recipient of the NASA Exceptional Service Medal, the Langley Research Service Award, and the Lara Taber Barbour air safety award. He was afterward professor of aeronautics at George Washington University (Peninsular Campus). His outside activities included service as a docent at the Mariners Museum at Newport News, a member of the Society for the Preservation of Virginia Antiquities (York County Chapter), and a member and past president of York County Kiwanis Club. He is survived by his wife, Doris. I'm sorry I never knew Philip but now see that he was interested in the local historical society, an interest that I also follow locally.

Arnold Compton Childs died at Sarasota, Fla., last February. He was for 25 years marketing director for Sun Oil Co. in Philadelphia, then retired to Campton, N.H., and more recently to Sarasota, Fla. He was a Mason, a member of the Penn Valley Church in Woodstock, N.H., and later a member and trustee of the Radnor Methodist Church in Sarasota. He had also been involved with the Boy Scouts of America. He is survived by two sons, Robert of Rye, N.Y., and Ronald of Benin, Nigeria; a sister, Barbara Childs Spender of Palm Harbor, Fla.; five grandchildren, and two great-grandchildren.

Daniel M.C. Hopping died December 26, 1990, at Bronxville, N.Y., after a heart attack. He was an architect who specialized in restorations and supervised the installation of 14 historic American rooms in the Metropolitan Museum of Art. His interest in restoration began with the acclaimed reconstruction of the 1675 Jan Martense Schenck House in the Brooklyn Museum in 1961. He was a consultant on the restoration of the Barton-Pell Mansion in Pelham Bay Park in the Bronx. He is survived by his sister Margaret of Bronxville. It is too bad he didn't get to Portsmouth. I think we still have more early houses (150 to 300 years old) left here than most early settlements.

William Oliver Christy of North Augusta, Maine, died last March. After graduation, he worked for Goodyear Tire and Rubber Co. in the machine division for four years. After the first year, he married Esther Mae (which he said was his best decision since graduation). In 1935, he joined Du Pont at the Buffalo Rayon Plant and later served at several other locations in various capacities. In 1956, he was transferred to the Savannah River Plant of the Atomic Energy Commission, which was operated by Du Pont and which he then said was the most fascinating and stimulating engineering task of his career, and it must have remained so as he stayed until he retired. He served as president of the North Augusta Exchange Club and also as president of the Aiken County Red Cross. He is survived by his wife, Esther Mae, one daughter, Elizabeth Waggoner, now in Richmond, Va., and one granddaughter, Christy Louise Waggoner also in Richmond.

Albert Nagel, Jr., died July 14, 1990. A Boston native, he attended school in Walpole and was lucky to find a job there with Multibestos Co. (a Dewey and Almay subsidiary) in 1932. He was involved in inspection, planning, and finally development work. He was later with L.F. Fales Machine Co. in Walpole and the Du Pont Experimental Station at Wilmington. In 1940, he married Ruth, whom he said he should have married in 1933, and in 1942 went with Polaroid as a chemical engineer (later as safety engineer until retirement in 1973). The 25th reunion book lists him as manager of the baseball team and includes his comment: "Since my work brings me in contact with the personal problems of many people, I should realize that I am a pretty lucky fellow in spite of the fact that I got out of school in the dismal days of 1931." Survivors are his widow Ruth, Hanover, Mass.; a son Albert F. of



Albert Ward Dunning, '32

Hanover; two daughters, Jean Marsh of Hanover, Mass., and Mary E. Nagel of Yarmouth, Maine; and four grandchildren.—**Wyman P. Boynton**, secretary, 668 Middle St., Portsmouth, NH 03801

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Our classmate, **Albert Ward Dunning**, a daredevil flight pilot, has written a book for his relatives and children, *Air Ventures and Airy Nonsense in the 1930s*. In it, he describes how he was thrilled by Lindberg's flight to Paris in 1927 and immediately determined to be a flight pilot himself.

After graduating from MIT, he had intensive flight training at Squantum and Pensacola, received his Navy wings in July 1933, and was attached to the carrier *Saratoga* as part of the red hot fighter squadron. He tells of how blind flying (flying by instruments only) was introduced and his part in making the practical adaptation to this method. After the Navy, he joined Monsanto Chemical Co. as a pilot salesman, calling on aircraft manufacturers and the airlines. He vividly writes of his seven experiences with major crashes, fires, and forced landings alone.

Al finally settled down, married Lois Thompson and was blessed with three children. With the coming of World War II, he went back into uniform and served in Washington and Philadelphia in charge of the Technical Division of naval aircraft supplies.

He concludes his book with the following: "Friends have asked me why did I not just wait for good weather on so many frightful occasions. Why not sack up in a motel and read a good book or listen to the radio? Why does a mountain climber have to climb a mountain? Because it is there. The same is true of flying. Every flight is a challenge and an adventure. The danger is that when you become good and you know you are expert, you exceed the capability of yourself and your equipment. God won't always let you get away with it.

"On the other hand, those who don't accept a challenge will never know that satisfaction of overcoming adversity. Life itself is a challenge and, in its truest sense, I like to believe it is everlasting."

After the war, Al went back to Monsanto, soon became a vice-president, and spent a good deal of time in Japan. He took early retirement and became vice-president of Plastic Coating Corp. After a while he formed his own company, Dunning Associates, Inc., specializing in electrostatic powder coatings. He concentrated on the gyro motor industry. They were essential for missile guidance, aircraft navigation, and of course the space program.

His company prospered, and he sold out at age 75 for a capital gain and a five-year consulting fee. His wife, a teacher, was a great help to him especially through periods of transition. She experienced a mild stroke, and he had a scare from heart palpitations. The Dunnings sold their beautiful waterfront property and bought into a condo retirement community. They play bridge, golf, and attend concerts. Al's son, Ward, is flying United Boeing 767s over the North Pole to England and Europe.

At present he is doing research and writing on *The Magic of Magnetics*, a treatise on the relatively untouched sources of practical energy. He hopes to make a perpetual energy machine, drawing on the electromagnetic fields that surround us. Al is looking forward to our 60th Reunion, and we are looking forward to seeing him.

John Brown is busy arranging preliminary meetings in preparation for the 60th Reunion Committee's meeting in September. He reminds us that at our 50th Reunion, 96 class members out of an active member list of 399 attended. We now have 234 active class members, and it is predicted that 34 will attend (a total of 50 with guests). My personal guess is that we will have 40 classmates at our 60th.

Our president, **John Brown**, on behalf of all class officers wishes to extend a Merry Christmas and a happy and healthy New Year to all our classmates.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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We have the following deaths to report. . . .

Ralph Peterson died November 11, 1990. His grandson, Alex Thomas, lives at 7702 E. 45th St., Tucson, AZ 85730. . . . **Lawrence C. Kingsland**, MD, died April 18, 1991. Dr. Kingsland was chief of Emergency at Santa Cruz Community Hospital, had been a pediatrician in Hingham and Cohasset, and had studied computer-assisted medicine and artificial intelligence at Brown and the University of Missouri. Mrs. Kingsland may be reached at 36 Robak Dr., La Selva Beach, Watsonville, CA 95076. . . . **Gerard M. Kincade, Jr.**, died June 20, 1991, in Pittsburgh. He was former vice-president of St. Regis Paper and a councilman of Thornburgh, Pa. Mrs. Dorothy Kincade lives at 717 Windvue Dr., Pittsburgh, PA 15205.—**William B. Klee**, secretary, Box 7725, Hilton Head Island, SC 29938, (803) 785-7746

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On our way north from Hobe Sound, Fla., where we spent the winter, we met Jean and **Dick Sanders** at Vero Beach for a brief visit. They enjoy reasonably good health. Dick still flies his airplane. They go to Annapolis, Md., for the summer and hope to make the 57th reunion at Montebello, Ontario, Canada in September. . . . Jean and **Art Esslinger** spent part of last winter on Hutchinson Island, near Stuart, Fla., not far from us. We had a nice visit on the telephone. They expect to return again next winter. . . . Jeanette and **Ernie Massa** are still at Pompano Beach, Fla., for the winter and on Cape Cod for the summer. Ernie lost his brother Frank last year. Both of them were close friends of the late Doc Edgerton, '27. . . . Leta and **Cass Belden** called me about the reunion. They have spent considerable time and energy on the arrangements and program for the reunion at Montebello. It promises to be a wonderful affair. Mary and **Ed Geittmann** are going to visit them on the way to the reunion. They are driving from Hartland, Wis.

I made three enjoyable contacts during the June class agent's telethon. . . . **Alex Blakely** has moved from Glenwood Springs, Colo., to Tennessee. He had brain surgery in the spring of 1990 and the lower altitude was better for his recovery. He is enthusiastic about golf and especially enjoys watching it on TV. . . . **Charles Sanders** still lives in Chatham, Mass., and winters in Naples, Fla. He attends alumni club meetings there. . . . **Virginia Davidson Blakeman** lives in Cataumet, Mass. She lost her husband, Tom, last January. Her daughter takes good care of her. She suggested that the Alumni/ae Fund accept credit card contributions. The office said they expect to do this for the 1992 fund year.

Leland S. Person responded to my class agent's letter. He resides in the Holden Nursing Home,

Holden, Mass., and is confined to a wheelchair. His attitude is good and he likes to walk twice a day, with crutches. He has arthritis. Friends and relatives take him out for meals, and he says, "Life could be worse." . . . Before leaving Florida, I had a nice letter from Thelma Lorenz. She is keeping busy with all her activities and friends at church and in the community.

I spent most of the winter in the dental chair. The work was successful albeit expensive. Like an old horse, my teeth seem to be falling out. Ellie and I look forward to seeing many of you at the Montebello reunion.—**E. Philip Kron**, secretary, 57 Huxley Way, Fairport, NY 14450, (716) 223-0196

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A note from **Leo Beckwith** written in May said he had missed seeing me when he came back to Swampscott "this time of year. You would have enjoyed yesterday. I attended the inauguration of our new president, Charles Vest. It was beautifully done and I was impressed. Wish I could report all the class of '35ers I saw, but there weren't any. But there was a delightful program, with bands and scholarly processions and clever poems by professors. It was cold and cloudy until President Vest got up to speak, then the sun burst out."

I received a note from **Walter (Stocky) Stockmayer** with comments on an article I had sent him on polypropylene and a very interesting article on "New England's Microbreweries: Putting the Zing back in Beer." Stocky served as an "expert" for DuPont's case involving Hercules and an Italian company in a 10-year legal battle on patent ownership of polypropylene. Re the beer: in the 1980s two young Vermonters founded the Catamount Brewing Co. in White River Junction to produce once more in the New England tradition a truly distinctive old-world beer. It was probably the first new brewery in New England since the turn of the century. Microbreweries are defined as those produce fewer than 15,000 barrels a year. (One barrel holds 31 gallons.) There are over 100 of these countrywide with a combined volume of only a fraction of 1 percent of the nation's full output. The Pacific Northwest, where they first began to burgeon, accounts for 7-8 percent of sales. Probably the best known of New England microbreweries is James Kock's Boston Beer Co. with its celebrated Samuel Adams Boston Lager. Kock is a sixth-generation Boston brewer and loves to tell that "my family was making beer when Eberhard Anheuser was selling soap." One of his first out-of-town accounts was an order for "home" use on Air Force One and at Camp David. All of this leads up to Stocky's saying they will serve me some Catamount when I visit in the fall of '92.

I am sorry to report the death of another of our '35ers. **Bernard Whitman** died at his home in Marshfield, Mass., on June 26 after a long illness. He received an aeronautical engineering degree with us and went to work in MIT's guided missile program, then worked until 1958 in the Instrumentation Lab as manager of research. He helped develop the Chance Vought Corsair. Bernard was best known for his magic shows and became chair of the International Brotherhood of Magicians in 1959. He created the Fu Ling show, in which he was a Mandarin master of mystery. He spent 16 years as chair of the Industrial Arts Department of the Weymouth Public Schools. He is survived by his wife, Mary Ruth, and a brother, Francis C., of Ft. Myers, Fla. I am sending our condolences to his widow on behalf of his classmates.

I received a nice letter from an old friend and fellow oarsman from the class of 1934, **Robert K. Roulston**. He summers in the Ossipee Mountains close to my old summer playground. He and wife Barbara spend their winters in Ocala, Fla.

Incidentally, I shall be back in the Boston area for a few days in September. On September 21 at the Alumni Leadership Conference Luncheon, I am being given a Lobbell Distinguished Service

Award "for loyal and dedicated service to my class." I can tell you I find it difficult to be casual about this, and I feel safe in telling you about it since it is to remain confidential until September 21, and by the time you read this it will be well past that date. . . . Now, how about some letters!—**Allan Q. Mowatt**, secretary, 715 N. Broadway, #257, Escondido, CA 92025; (619) 432-6446

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Continuing **Al Horton's** experiences with President Karl Compton: In April or May of 1936, Al was asked to serve as administrative assistant to the president for three years. "My most demanding function was as secretary of the Committee on Engineering Schools of the Engineers' Council for Professional Development, of which Dr. Compton was chairman. The Committee accredited engineering programs throughout the United States, and I arranged the subcommittees."

Al writes that the Comptons were a remarkable family. "The father, Dr. Elias Compton, was, when I first met him, president of Wooster College, Ohio. Three sons were educated there. Karl became head of the Physics Department of Princeton and then was appointed our president. Arthur, was later head of Princeton physics and in 1927 won a Nobel Prize for his discovery of x-ray properties. A sister married the president of the University of Bombay. I was fortunate in getting to know all these members of the family. They had a summer place at Otsego Lake on the northern peninsula of Michigan where I learned the art of canoe jousting—a stern paddler on each of two 16-foot canoes and a second occupant with a 10-foot pole to which was attached a large boxing glove. The rest I leave to your imagination!"

At our recent reunion, **Harold Miller** recalled meeting President Compton in 1938 or 1939 near the old Coop. It was a cold day, and he wore neither hat nor coat, yet talked unhurriedly with Harold. In 1956, Harold heard **George Trimble** address the American Bankers Association at a Florida meeting on the subject of aviation. In Tokyo at another time Harold saw **Tom Kato** and **Ishiro Takahashi**, '37. During World War II, both were treated harshly by the Japanese Army, because of their ties to MIT, which was doing great things for our side.

Now, to finish with San Francisco Bay Area contacts. **Bernie Gordon** had written that he would be in San Diego at the time of my visit, teaching a course in "Soil Aspects of Embankment Dams." Like many in the class, he is still consulting, teaching, and lecturing. "This gives Dottie and me a multitude of opportunities to travel." At home she golfs, he hunts, and they raise and train hunting dogs. Bernie followed Course I with graduate work in soil mechanics at Harvard for an MS. In the 1960s, after Los Angeles' Baldwin Hills reservoir failure, Bernie was appointed by the governor to a special committee to determine the cause and make recommendations.

The January 1991 Notes mentioned **Ransom Pierce's** giving a kidney to save his daughter's life. He also is without the sight of one eye from a cataract operation in 1942. Yet he is active in golf and still plays singles tennis. Ransom joined our class as a Naval Academy graduate and spent three years in Course XIII-A. During the next 15 years, he was assigned to the Mare Island shipyard and to Honolulu and Washington State. Then followed 30 years of consulting on major projects. One of these was the redesign of Santa Rosa's water system to double capacity. Ransom's wife uses a wheelchair, but they are happy with "two fine children of whom they are very proud, and three grandchildren."

Joan and Emanuel Rapoport had recently moved to 5024 Fulton St. in San Francisco, looking out on Golden Gate Park. He was course XV and for many years was in investment banking, serving as managing director of Sierra Capital

Corp., a venture capital firm. Manny came to America from Austria at the age of 18. His fluency in German and other languages landed him in psychological warfare in World War II, based in England. Joan, who hailed from England, was a radio newscaster in Chicago where they were married in 1943. In 1945 she got back to England as a war correspondent for the *Chicago Times*. One of Manny's postwar ventures was a study of Brazil's interior, involving a thousand mile highway into the wilderness. Brazil presented him with a commemorative plate, decorated with a map of the highway.

Now for more on the 55th reunion. At Cambridge the meals at McCormick Hall were excellent. Thursday morning **Herb Borden**, **Henry Johnson**, **Milner Wallace**, and I manned a four-oared shell on the Charles, with Manager Harry Essley and Head Coach Stu Schmill in the launch. Harry, and Milner's daughter Robin Loveland, took video movies. When you see then at the 60th, you will agree that we need lots of coaching, but it was fun. After lunch at the Faculty Club and the class photo on the steps of Sloan, we held the class meeting at McCormick, where **Dorian Shainin** gave his always-amusing patter of one-liners. For example, "The hardest simulation to put on: Acting sad when the children and grandchildren leave after a one-week visit."

Although the musical numbers of the featured duet at Pops were not tuned to our vintage and Sousa's "Stars and Stripes Forever" was missing, the rest of the program was good old Pops. No ankle-deep rainwater on Mass. Ave. as at the 50th. At Friday's Tech Day luncheon in the Athletic Center, we had five tables of classmates, wives, and guests. My guess is that 45 of the Class participated in one or more events of the five days, either at Cambridge or Cape Cod or both.

The Wianno Club was a treat, friendly and obliging, with top-notch food. Between golf, tennis, swimming, sailing, shopping, and sightseeing in beautiful weather, everyone had a good time. Some of the activity was video recorded for posterity, or at least the 60th, and particularly for **Jim Baker**. . . . Several of those attending were on our "most wanted" list: class members whose names have not appeared in this column for five or even ten years. **Pat Patterson** and I managed to get one-on-one conversations with some, plus promises of informative letters from others. Our reports will spread over future issues.

On my way to reunion, Carol and **Jim O'Neil** gave me a home away from home in lovely Sherborn for two days. So I was able to renew an old fraternal tie with several classmates. Jim was Course I, and started his career doing highway, dam, and bridge construction in Pennsylvania, Minnesota, New York, and Greece. . . . He served with the 6th Armored Division in New Guinea and Manila and came out a Lieutenant colonel. Jim finished with 31 years for Pittsburgh-Des Moines Steel, staying till age 67 at the company's request. In retirement he has organized a card system of Sherborn family names from records started by a Civil War veteran and chaired the Council on Aging.—**Frank L. Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson**, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

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55th Reunion

A preliminary meeting was held in June by class officers **Phil Peters**, **Dick Young**, **Ralph Webster**, and **Bob Thorson** regarding our 55th reunion, which will be at the Viking Hotel, Newport, R.I., on June 1, 2, and 3, 1992. You will receive separate mailings with further details.

Bill McCune recently retired as chair of the Polaroid Corp. Welcome to the ever-growing group of class of 1937 retirees, Bill. . . . **Bill Case** retired in 1981 from J. Sklar Mfg. Co., where he

was the purchasing agent. Bill writes that he heard that **Charles Healey** and his wife have given up their Princeton, N.J., home and have moved to a retirement home in that area. Bill also heard from **Cliff Lytle**, who is in good shape and surrounded by his large family in Thomaston, Conn.

Jim Ewell retired in 1978 from Procter and Gamble Co., where he was senior VP and director. Jim is a board member of the Cincinnati Symphony Orchestra, past president, and chair. He oversaw design and construction of "Riverbend," the symphony's summer home (capacity 5,600 under roof, 12,000 on the lawn, Michael Graves architect). Jim is also a board member of the Cincinnati Children's Hospital, past president, and chair. He is currently overseeing a \$100-million-plus building expansion of the Indian Hill Historical Society, and has just finished complete restoration of one of the village's early houses as headquarters of the society. He and his wife Bette also do a fair amount of travel, which they both enjoy immensely.

Walt Wojtczak and his wife June divide their time between Florida and New Hampshire. Walt has recovered well from prostate surgery in April; June will have cataract surgery in August. Walt is still playing lots of tennis, swimming, and gardening in New Hampshire. They usually take a trip west and end up in San Diego, where their son Rick lives. Their daughter lives in Connecticut and they see her often while they are in New Hampshire. Walt retired in 1985 from Standard Builders, Inc., where he was senior VP.

Joe Smedile writes that his wife Martha had two more strokes, one in April and one in May, and made good but not complete recoveries in both instances. Then on June 12 she had a major stroke, became very weak, and is in a nursing home. . . . Heard from **Tom Hallenbeck**, who writes that he and Peg are "still alive, but less and less activities" for him. . . . Received a note from Roman Ortynsky, class of 1936, informing us that **Harry Sommer** lost his wife Margery on March 11, 1991.

Herman Brettman passed away on June 11, 1991. Herman was a real estate developer in Salem and Lynn, Mass. He was chair of the building committee for the Jewish Rehabilitation Center for the Aged in Swampscott, Mass. He leaves his wife Beatrice; a daughter, Ronni Freeman; a son, Dr. Lee; and four grandchildren.

Thomas Hennessy died of cancer on May 14, 1991. Tom was an architect who had retired to Palm Beach Gardens, Fla. He was a partner in two New York architectural firms, Schoen & Hennessy and Berger & Hennessy, and a consultant designer for the American Hotel and Motel Association during a 40-year architectural practice in Manhattan. He is survived by his wife Kathryn; a son, Paul, of San Jose, Calif.; a daughter, Joan Syms, of Newton Upper Falls, Mass.; and four grandchildren.—**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890

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We deeply regret to report the death on September 13 of **Haskell Gordon**, our class VP, following an automobile accident. Just before the accident, he sent in this mini-biography: "After spending 10 years working on experimental designs for carrier-borne aircraft as a civilian aeronautical engineer in Philadelphia, I finally left and went into business with two partners in Worcester, Mass., Ina's former home. We started with discount department stores and branched out to shopping centers in 10 central Massachusetts cities. I finally retired in January and my son Larry, (Sloan School, '79) took over as chief operating executive. In my spare time through the years, MIT has always been my first priority, but I have also been deeply involved with the Boston Symphony Orchestra both in Symphony Hall and in Tanglewood. In addition, my involvement branched out to directing construction of a number of commu-

nity buildings. One of the most interesting jobs fell my way three years ago when the BSO became interested in designing and eventually constructing a new outdoor concert hall for chamber and solo presentations, and a home for the student orchestra at the Tanglewood Music Center. I was asked to work as a consultant on the design committee, together with the architect Bill Rawn ('79) and the acoustics expert. The design is absolutely magnificent in scope and will seat 1,250 inside and 500 outside with perfect sightlines to the podium and excellent sound. There is also room for another 2,000 outside, with good sound but inadequate vision. The acoustics should be excellent, as we have studied every outdoor concert hall of consequence in the United States and Canada and have taken great care in designing every corner that might cause problems. The exterior design of the structure will fit in exquisitely with the surrounding nearby buildings. The master plan of the entire 120 acres of this project was done by William Porter, head of the MIT Architecture Department. The overall dimensions were scaled to resemble a shoebox design, not unlike Symphony Hall in Boston, Musicverein in Vienna, and the Concertgebouw in Amsterdam, all perfect listening halls. We are also adding special acoustic drapes at inboard stations to allow John Williams and the Boston Pops and Sergei Ozawa and the BSO to make recordings. We may be able to extend the summer season from June to September, as there are many orchestral organizations in the Berkshires that are seeking a good acoustical home. The BSO development group has already received pledges of close to \$5 million toward a projected cost of \$8.7 million, so it is quite conceivable that construction can start in 1992." (Ed. note: We're sure that Haskell would not object to gifts from his classmates).

In other news, Jean and I just had a delightful visit with Alice and **Mert Barrows**. They have been traveling up and down the East Coast giving parties to celebrate their 60th wedding anniversary. I got in on it because Jean was a friend of Alice's; being a classmate of Mert's was a mere coincidence. As many of you know, Mert was caught in the Depression, worked, started a family, and went to school at Beaux Arts until he earned enough to spend his last two years in Course IV (architecture) at the Institute. In 1938 he joined Royal Barry Wills Associates and, except for two years in the Seabees, spent the rest of his career with them, serving as president from 1962 on. Since his "retirement," he's been enjoying the best of both worlds, taking only the commissions he wants. During the 40-plus years he was in Boxford, Mass., he left a legacy of dozens of home designs, a police station, and improvements in his church building and steeple, as well as a volunteer life on the school committee, the Historical District Commission, and various church committees.

I don't know when you'll get this (I'm writing it in July), but shortly thereafter Sandy and **Lou Bruneau** will be celebrating their 50th. The day of their wedding (December 7, 1941) was recognized by President Roosevelt as a day that "shall live in infamy." . . . We regret to report the death of **Warren Thomson** of Edgewood, Md. Warren was on the *VooDoo* staff with me before he saw the light and started studying physics instead of wasting his time on a comic magazine. After the Institute he worked successively in the government, in the MIT Operations Evaluation Group at the Navy Department, and in various positions at Galandet College, as well as free-lance writing and editing. Later on he volunteered for Meals on Wheels and similar programs. His final volunteer act of donating his body for medical research is one that might have food for thought for us all—the donation of organs when we have no further use for them may well be of inestimable help to someone else.

The following excerpt from a letter by Paul Fasolo ('91), a class of 1938 scholar, speaks for itself: "I am writing to thank you for your financial support during my final year at MIT. I am proud

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to be considered a graduate and a class of 1938 scholar!

"Reflecting upon my education at MIT, I am especially grateful for the weight it carried in assisting me with summer internships and graduate school admissions. The three-and-a-half years of practical research-oriented experience I gained through the Undergraduate Research Opportunities Program was highly inspirational. Generous people like yourself are important contributors to organizations such as this, and it gives MIT another dimension of academic prowess which is lacking at other institutions.

"Thank you again for your magnanimity, and I hope to follow in your footsteps someday. After all, being able to finance an MIT education is one big key that opens the doors towards many lucrative opportunities."

Your secretary is enjoying an extended vacation in New Hampshire; his assistant is recovering from a cataract operation and working with one eye.—**Don Severance**, secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley**, assistant secretary, 50 Spofford Rd., Boxford, MA 01921

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Dodie Casselman fulfilled another lifetime ambition, to see the majesty of Mount Whitney and tour Alaska. On the homeward leg of her trip, she was welcomed for dinner and the evening at the Washington Women's University Club by members Jean Sullivan, Wellesley '39, and Janet Rosenberg, Wellesley '40. Mary and **Jim Barton** and Hilda and I were invited to join the mini-reunion. Conversation was lively the whole evening as we re-confirmed that reunions, whether large or small, enrich memories generated over lifetimes.

Professor Earl Murman stimulated and inspired about 50 alumni/ae who heard his report on Project Athena at the August meeting of the MIT Club of Puget Sound. Professor Murman is head of MIT's Department of Aeronautics and Astronautics and, from 1988 to 1991 he served as director of Project Athena, the large-scale campus computing experiment finished in June 1991 after eight years of intense activity. Athena provides a distributed, yet centrally managed, computing access via Unix workstations to the entire MIT campus, totaling about 10,000 users. Attendance at Professor Murman's presentation, when it comes to your nearest alumni/ae club, is enthusiastically recommended. A bonus for me at the Seattle meeting was being seated, by coincidence, next to George Hadley, '65, son of Ed Hadley, '38, assistant secretary of the Class of 1938.

Dora and **Paul Stanton** and June and **Otto Morningstar** were pictured in the MIT *Spectrum* newsletter attending the West Palm Beach luncheon for MIT Sustaining Fellows. Also in *Spectrum*, and among the distinguished guests pictured at the inauguration of Charles M. Vest, MIT's 15th president, was **Jim Barton**, chairman of our 50th Reunion fund drive.

Manning Morrill sent a photo of a picture taken on Mt. Kahtahdin in Baxter State Park, Maine, in 1937 of Roy Whitney, head of Bangor Station for the Chemical Engineering Practice School; Jack Rothschild, a graduate student; John Cushnie, '39; and himself. Unfortunately, it could not be reproduced here.—**Hal Seykota**, secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 98335

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There have been a few responses to the notice in the August/September column about the possible mini-reunion in January, 1993. **Barry Taft** writes, "You can count on Marge and me for the mini-reunion in Naples, Fla. Naples is about 200 miles from Maitland (Orlando area) by the shortest route, and about 225 miles via the preferred all-interstate route. That's less than a four-hour drive

for a lead-footed Florida driver."

From Sun City Center, Fla., **Samuel Omansky** writes, "There are, as you mention, many good motels in addition to the Beach Club, but it should be pointed out that January is the height of the tourist season and there may be a limited number of rooms available at that time. January is usually quite cold here in west central Florida, but Naples is far enough south along the coast so that it would not be a major discomfort factor. In addition to the attractions that you mention, there is also a good dinner theater in town. Please keep us posted on the plans as they develop; as of now, we plan to be there."

Walter Kahn telephoned from Westport, Conn., to say that he is very interested, and would like to see a mailing go out to the whole class. He even volunteered to help with the cost of the mailing if necessary. He is familiar with Naples, and the Naples Beach Hotel, which he says has an excellent location and a fine beach and golf course nearby. He considers it the third best hotel in town, after the Registry and the Ritz.

There is also a long letter from **Alvin Gutttag**, parts of which I shall quote. "The mini-reunion plan for Naples in January 1993 sounds great, and Norma and I plan to attend.

"The August/September *Technology Review* brought back some fond memories. I was sorry to read of the passing of 'Brer' (Frederick G.) Fasset. The heading 'Friend, Counselor, Teacher' indeed did fit him. A number of years after graduation I enjoyed a dinner with him at the Old Ebbitt Grill in Washington. If you don't know why I call him Brer Fasset you obviously didn't have the privilege of taking English with him. I still have my copy of Fasset and Eaton's *Practical Writing*. If I remember correctly, his daughter Jane was a member of our class for a couple of years. Was glad to see that Thomas R.P. Gibbs (V Chemistry in the *Review*) is still around. He is correct that some of his former students are retired. I am one of them.

"After living in the Bethesda area for over 40 years, we sold our house in June in preparation for going to Asbury Methodist Village, a retirement community. In moving from a six-bedroom house with enormous storage space to a three-bedroom apartment, we have had to get rid of a lot of things. Thus the 1,200-plus books we gave to charity did not even dent my library. I do have a few words of wisdom for those who have not yet sold their homes but plan to do so. Do not have a garage sale or a yard sale. Have a trash sale! It is unbelievable what people took from the mounds of trash we put out (and this was after we gave things to charity and our children). Our new apartment address will be 415 Russell Avenue, Apartment 108, Gaithersburg, MD 20877.

"Of course, I am still running, but have had to change my routes. Also, I have cut back a bit and will only do about 2,100 miles this year. On short run days, I do a little over four miles, and on long ones, six and a half to seven and a half miles. I race occasionally up to ten miles, and once a year, still do a 20K race. My times are getting slower. At present, I am about five minutes a mile slower than my best times.

"Also am still inventing. One of the patents has issued on my procedure for eliminating getting newspaper ink on you hands. No sales yet. A patent should issue soon on my method for preventing people from washing cancellations off stamps. (The Post Office estimates that it loses about \$50,000,000 a year from such washing, and the British believe they lose about one-third as much each year.) The patent also includes claim directed to preventing the alteration of an Expert's mark on a philatelic item."

Russell T. Werby passed away February 13, 1991, while on a vacation trip to Mexico. Russ served as captain in the U.S. Army Chemical Corps during World War II. He took over Werby Laboratories in Boston, an analytical laboratory for government, industry, food services, and academic research, as well as the New England resource lab for organic and inorganic analysis.

Russ was active in the Northeastern Section of American Chemical Society affairs, and served in a number of elective and appointive positions. He acted as advisor to cooperative students at Northeastern University, as well as to other students, where his wife's counsel encouraged many to continue in chemistry careers. Russ was also a member of several singing groups and choral societies, and a long-time member of Brookline Town Meeting.

I recently received a letter from class president **Norman Klivans** with further discussion of the 1995 55th reunion at Newport, R.I. With other local class members, I shall try to visit there and scout out a few hotels. Norm suggests that we might want to be in Newport on Friday afternoon, following Technology Day, staying through Saturday and possibly Sunday afternoon. We would welcome your comments on these tentative plans. Please send them to—**Richard E. Gladstone**, secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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The echoes of our successful 50th Reunion, continue to resound. My copy of the class picture in front of Kresge arrived in Bethesda the day after the reunion report for the October Class Notes, was mailed. In the front row **Bob (Wallace) Blake** held a sign sending greetings to Charlotte and **Will Mott**. This may have seemed strange to attendees who had seen the Motts at various reunion functions. They left Chatham Bars to prepare for an informal reception for 100 guests at their home in White Plains, N.Y. The occasion was the ordination of their daughter, Pamela, to the deaconate of the Episcopal Church by the bishop of New York at the Cathedral of St. John the Divine on June 8. Congratulations to Pamela. We'll forgive the Motts for skipping part of our reunion to attend such an important occasion.

Class of '41 oarsman of the Washington, D.C., area enjoyed their reunion row on the Charles so much that **Charlie Butt**, **Bob (Wilson) Blake**, **Chet Hasert**, **Erling Hustvet**, and **George White** took out a four-oared shell (sweeps with cox) from the Potomac Boat Club in Georgetown on July 19. They plan to continue weekly rows. **Sterling Ivison**, **Charlie King**, and **Bob Smith**, when available, hope to join them in an eight.

A letter from **Larry Turnock** enclosed an article from the May 1991 *Law Alumni News Bulletin* of Case Western Reserve School of Law. Larry graduated from Case in 1948. In the article, "Focus on Capitol Hill," the writer interviewed six Case graduates. The "dean of the law school's Capitol Hill delegation" turned out to be **George White**, Case, '60, but MIT '41 to us. George, "the architect of the Capitol," obtained an SB in electrical engineering with us and studied architecture as well. He also has an MBA from Harvard. Employed as an engineer with G.E. for seven years, George joined his father to practice architecture. In 1971, he went to Capitol Hill. Now only about 30 House members and eight senators have been there longer! With his staff of 2,700, he is responsible for design, construction, and maintenance of all buildings on the "hill." These buildings include the Capitol, the Supreme Court, Congressional Office Buildings, and the U.S. Botanic Garden, and contain 12 million square feet, house 25,000 employees, and are surrounded by 250 acres of grounds (also his responsibility). Local '41ers hope to convince him to lead us on a tour.

Harry H. Wasserman, the Eugene Higgins Professor of Chemistry, retired June 30 after a 43-year career at Yale University. On May 4, British publisher, Robert Maxwell, new owner of the *New York Daily News*, donated \$500,000 to the Yale Library in Harry's name. The surprise announcement was made at a gala, following a day-long symposium, focused in part on his scholarly contributions in the field of organic chemistry. Harry, editor of *Tetrahedron Letters*, an international or-



Organized by Charlie Butt, 50th Reunion Class of 1941 launched two boats on the Charles on Technology Day last June. From left: Joe Gavin, Bob Smith, John Potter, Mal Abzug, John Murdock, Carl Mueller, Charlie Butt, Bill

Folberth, Chet Hasert, Ed Hayes, George White, Bob (Wilson) Blake, Charlie King, Erling Hustvedt, and coxswain Bob (Wallace) Blake. Missing are Dave Howard and Sterling Ivison.

ganic chemistry journal published by Maxwell's Pergamon Press, and the publisher intend the gift to "extend the current services of the chemistry library and pioneer new developments in information transfer involving electronic technologies."

A Course V graduate of MIT with a PhD in chemistry from Harvard, Harry has received many awards from national societies for creativity in organic chemistry, distinguished scholarship, excellence in teaching, and research excellence.

Kenneth A. Roe, a past president of ASME and chairman of Burns and Roe Enterprises, Inc., Oradell, N.J., died June 3, in Fort Lauderdale, Fla., after a truly distinguished career. His many honors have been mentioned in these columns by **Sepp Dietzgen** over the years. In 1938, he joined Burns and Roe, an engineering and consulting firm founded by his father. It would be difficult to name important advanced technology programs with which he was not associated in his career. Fossil fuels and nuclear power, Projects Mercury and Gemini, fluidized bed combustion, fuel cells, magnetohydrodynamics, cogeneration, and synthetic fuels are a partial list of the many to which he contributed.

Ken received a BA from Columbia in 1938, an SB in chemical engineering with our class, a certificate in naval architecture from the U.S. Naval Academy in 1942, an MS in mechanical engineering from the University of Pennsylvania in 1946, and honorary doctorates from Stevens Institute of Technology in 1978 and Manhattan College in 1989. He was a professional engineer in 11 states. His family has established a scholarship fund in his name as a part of the ASME Foundation.

Kenneth A. Tsunoda passed away June 20 in Portland, Ore., as a result of an automobile accident on May 29. Ken was president of Transflex, Inc., Clackamas, Ore., and had been president of Siegling-America, Englewood, N.J., for 27 years before moving to Oregon four years ago. He was a registered chemical engineer and a fellow of the American Association for the Advancement of Science. I have pleasant memories of Ken as a vice-president of American-Messer in New York in the 1950s.

A note from E. Sharon Kinney, wife of **Walter J. Kinney**, tells us that he died on July 16, 1989, in Rancho Palos Verdes, Calif., "after a gallant but

losing battle with cancer." Walt was employed as a template maker at Douglas Aircraft after he left MIT in 1940. He became a multi-axis numerical control specialist in the office of the corporate vice-president of manufacturing, in Santa Monica, Calif., selecting this advanced equipment for all Douglas divisions. After the merger with McDonnell, he transferred to Long Beach, where he was instrumental in robotics, laser beam cutting, and other advanced manufacturing systems. He retired in 1983. . . . Our sincere condolences to the families of our deceased friends.

Remember, keep sending your news.—**Charles H. King, Jr.**, secretary, 7509 Sebago Rd., Bethesda, MD 20817, (301) 229-4459

42 50th Reunion

Please send news for this column to: **Ken Rosett**, secretary, 191 Albemarle Rd., White Plains, NY 10605

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My corps of correspondents having fallen silent, I am reduced to personal references, which I shall limit to three. June: performed in the chorus of a local production of Gilbert and Sullivan's *Mikado*. September-October: vacation trip with Susan to Britain, France, Italy. December: marriage in Tulsa of younger son, Tom (about time—he's 34).

This is most unsatisfactory. Please send news. Meanwhile, enjoy Thanksgiving, Christmas, and New Year; prepare for the 50th, which is only 18 months away; and send money, c/o **Stan Proctor**—**Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

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By the time you read these notes, many of you will be basking in the afterglow of the mini-reunion with the fond recollections of renewing old friendships and sharing yet another good time. We were delighted with the excellent postcard response, even though a good number were

unable to make it. We particularly appreciated those of you who took the time to pen a comment or two. Please don't wait for another mass mailing to let us know what's going on in your lives. We need news.

Doc Turner advised us that he would not be able to attend because his daughter was getting married that weekend. We wish the newlyweds all the very best. . . . **Trigg Noyes** wrote to tell us that just prior to the mini-reunion, he will have returned from a two-week canal cruise to and from Strasbourg. He'd like to see if there would be any interest in a get-together in Santa Fe, N.M. If this appeals to any of you, please let us know.

There are two deaths to report this month. **F. Maxwell Griffith** of Charleston, S.C., died in September 1989. He was in aeronautical engineering and a veteran of World War II. His notes of his experience in the Navy led to the writing and publishing of *Port of Call*. He is survived by two daughters, one son, and three grandchildren. . . .

Ralph Barrows of Pocasset on Cape Cod died in this year. He was a mechanical engineer for Western Electric for 25 years retiring in 1971. He, too, was a World War II veteran serving in the Army. He was president of the Cedar Point Association in Pocasset and commander of the U.S. Power Squadron, which awarded him its Order of the Pandion in 1988. We know of no survivors.

How about including in your New Year's resolutions one to write us with news of your exploits, major, minor, and otherwise? Co-secretaries: **Andrew Corry**, P.O. Box 310, W. Hyannisport, MA 02672; **Louis Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

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I have just returned from a week of down Maine sailing aboard my old Tartan 27 with T.R. "Pete" Hickey. We may be getting old and feeble but we can still make a boat move, particularly if there is wind or if the engine works!

Pete gave me his copy of our 10th reunion photo along with a list of attendees. My, but you all looked younger! How many of you remember the Hotel Curtis, Lenox, Mass., affair? There were

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194 attendees, including Professor John Rae and his wife, one or two kids, plus three guests from 1946. We even had a softball game with beer at every base, reminiscent of similar undergraduate affairs at Crane's Beach.

In early July Dorothea Johnston forwarded a letter and news clipping indicating that her husband, **Robert H. Johnston**, had been honored by the city of Tallahassee for his outstanding service as a volunteer. His activities include Meals on Wheels, Elder Care Services, Retired Senior Volunteer Program, as well as being an ordained elder and deacon of the Presbyterian Church, USA. In his former life Bob spent about 35 years as a chemical engineer at Exxon in Florham Park, N.J.

Steve Eppner, a retiree since September 1986, reports that they play a lot of golf, travel the world, and escape some of the winter to Florida. To quote, "Sure beats early morning V-12 calisthenics or the rat race of work."

Our brief comments regarding the deaths of **Bill Martin** and **Bob Schumacher** did them an injustice. Accordingly, the following obituaries more adequately detail their lives and accomplishments. Bill Martin was associated with Johnson Controls, Inc., for 33 years and for the last eight years was manager of the Northeast Region. Before his retirement to Williamsburg in 1989, he operated his own consulting firm for 10 years. He was a member of the American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc., and a Rotarian. He was active in the First Congregational Church of Darien for 18 years, serving on many boards, most recently as a deacon. Since his retirement, Martin had been an active member of the Williamsburg Presbyterian Church and was involved in the current building-fund campaign. He is survived by his wife of 43 years, Jeanne Robinson Martin; two daughters, Lynne M. Symon of Evanston, Ill., and Elizabeth M. Wright of Port Angeles, Wash.; two sons, William G. Martin III of Kennebunk, Maine, and Peter G. Martin of Libertyville, Ill.; one sister, Avis M. Heller of Milwaukee; and 11 grandchildren.

Bob Schumacher was a senior partner with the patent law firm of Fitch, Ever, Tobin & Flannery in Chicago, where he was in private practice since 1961. After graduation from MIT, he moved up the Charles River and graduated from Harvard Law School in 1950. He entered patent practice with the patent department of Socony-Vacuum Oil Co. (later Mobil Oil Co.). After 10 years he was assigned to the firm's subsidiary, Well Surveys, Inc., in Tulsa, Okla., as patent attorney and corporate secretary. Well Surveys was the originator of nuclear well logging, the first commercial use of nuclear processes. The company grew and was ultimately acquired by Dresser Industries. In addition to managing the patent department, Schumacher conducted an extensive licensing program. He also continued to prosecute litigation for Well Surveys. Schumacher prepared patent applications on inventions involving theoretical aspects of electronics, thermodynamics, fluid mechanics, and physics. He is survived by his wife, Margaret Stocks Schumacher; a daughter, Doris McMorroff of Winnetka; two sons, Richard W. of River Forest and John W. of Indianapolis; four grandchildren, Peggy and Jack McMorroff and Joe and Peter Schumacher; and his mother, Doris E. Schumacher of Oak, Neb. Additionally, he leaves a brother, Richard W. Schumacher of Crofton, Md., and a brother-in-law, John A. Stocks of New Orleans.—**Clinton H. Springer**, secretary, P.O. Box 288, New Castle, NH 03854

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This is a kind of after-the-fact column since it comes quite a bit after the Kiawah clambake in October, where I hope a goodly number of our class attended the 45th Reunion. Sorry I couldn't make it, but I hope to get "briefed" by **Bob Hoff-**

man or some kind soul so I can fill in others who were in the same boat as I and pass along the good news in the February/March issue.

Other than that, there hasn't been much news except for lunch and a brief visit by old friend **Don Burke** and wife, Pata, who stopped by on their way home after a grand tour of the vast southwestern part of our country, seeing various family and friends as far as San Diego. It was an enjoyable afternoon. They went home to St. Petersburg by way of Santa Fe and points south and east.

Some sad news came through the Alumni/ae Association: the passing of old Course XVI acquaintance, **Mel Friedman**, last May 14, cause not listed. We have no bio on him other than he lived in Newton Center and was survived by his wife Natalie, daughter Pamela, and son Bruce.

That's all there is. Send me more!—**Jim Ray**, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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45th Reunion

John Martin retired in July as chairman of Flow-Mole Corp. and became chairman emeritus of Utilix Corp. (Flow-Mole's new name) in Kent, Wash. . . . **Alban Evenson**, a retired school administrator and teacher, died in June at his home in Visalia, Calif. He is survived by his wife, Epee, his daughter, Laurinda Curtsinger, and two granddaughters. . . . **Bob Anderson** died in November 1990 in Oberlin, Ohio. Bob was a former partner and officer of Whitaker-Myers Insurance Co. and had held many civic positions in his hometown of Wooster, Ohio: councilman, council president, and mayor. He is survived by four children: Kathryn Schaum, Oberlin; Karen Schreier, Madison, Wis.; Douglas, Provincetown, Mass.; Thomas, Petersham, Mass.; seven grandchildren, and one sister.

Sorry, people, that's all we have this month. Send news!—**Robert E. McBride**, secretary, 1511 E. Northcrest Dr., Highlands, Ranch, CO 80126

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Denny McNear continues as a consultant on a project relative to the Mexican business of Southern Pacific. He retired from the company in December 1990 and has been active with the chamber of commerce for both San Francisco and the state. He also has supported programs to interest students in science and math in preparation for engineering careers. In conjunction with a program at MIT directed by Professor Latani-son, Denny is working to arrange for high school science teachers to attend sessions at MIT for training. Working with a program funded by 3M, he is involved in curriculum development for kindergarten through sixth grade with the goal of reducing school dropouts.

Also, he is moving to 10 Turnagain Rd., Kentfield, CA 94904. He and Susan have agreed to divorce after 28 years of marriage. With the help of a mediator, they have divided their property. Denny's son, George, completed a teaching degree at Boston College in May, the last child to graduate. Two other children, Steve and Dan, work in Boston.

Phil Bragar has a granddaughter entering MIT this fall. She is skipping her senior year of high school. . . . **Bob Dean** and his wife, Nancy, live in Norwich, Vt. Last year they took their bicycles to Scotland and toured extensively. The weather was basically kind, but body+bike+baggage weights of 230-240 pounds made for hard work. They only had one downwind day, which was glorious. One grey, raw Sunday, they could find only Chinese take-out food and huddled on a bench on the town square to eat it. For accommodations, they stopped at information centers each day and found that night's bed and breakfast. After flying to Boston, they stopped for a bicycle outing during the drive home. Bob developed a problem, and two miles short of their home he asked to be taken to a hospital where his discom-

fort was diagnosed as a heart attack. Bob has recovered and is back to work at his company, Dean Technology, Inc. Nancy is a justice of the peace and recently performed five weddings. She also continues watercolor painting and sold a few recently at a one-person show.

Kay Brower is professor of chemistry at New Mexico Tech. He was awarded their Distinguished Research Award for 1991 because he has a knack for picking out important problems and solving them in a style that's clear and to the point. Kay made major contributions to understanding a process by which accidental explosions can occur in liquids, thereby improving safety. . . . **Bascom Birmingham**, retired director of the Boulder Laboratories of the National Institute of Standards and Technology (formerly NBS), has received the Collins award from the Cryogenic Engineering Conference. He was honored for his pioneering work with large-scale hydrogen liquefaction systems, his management of a diverse national program in cryogenics at the NBS, and his continued leadership over three decades. He was the first full-time, career employee at the Boulder, Colo., site. He served as director of the labs from 1971 until his retirement in 1983.

Charlie Adams died. He helped build the Whirlwind I computer at MIT. Whirlwind was the first vacuum tube, real time computer with an operational core memory. As a researcher and assistant professor, he also worked on an aircraft interception system based on Whirlwind. In 1959 he founded Adams Associates of Burlington, Mass., which later became KeyData Corp. He is survived by his wife, Elaine, and five children. On behalf of our classmates, I extend our sympathy to Elaine and her family.—**Marty Billett**, secretary and president, 16 Greenwood Ave., Barrington, R.I. 02806, (401) 245-8963

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In the yard behind the house at 85 Roosevelt Road, Cotuit, Mass., a town on Cape Cod, there stand two pine trees, 15 feet apart, five inches in diameter at their bases, and 40 feet high. Branches commence at an elevation of 15 feet, and it is at this height that a chain can be discerned spanning the gap between the trees. From the center of the chain, two ropes descend to support a swing seat at a height of 30 inches above the ground. What we have here is the swing designed and installed by **Harry Lambe** for the benefit of his grandchild, Ian, who is 8 years old, the son of Robert Lambe, '74. As Harry tells it, when he had completed the installation, he stepped back to gaze upon his work and found it good. He then tested the swing by sitting in it. Promptly, he found himself sitting on the ground, the swing seat beneath him. Overhead, the trees leaned towards each other and the formerly level chain was now in the shape of a V. Harry was puzzled by these developments and decided to apply science to the problem. The outcome was a formula that showed that Ian can swing his way contentedly into old age if the trees grow at 15 times their normal rate. (Note: On August 19, 1991, Hurricane Bob swept across Cape Cod, and when Jean Lambe looked out the window that afternoon, she observed that Ian's swing had gone with the wind.)

Your secretary learned about the swing at a 1949 reunion committee meeting held most enjoyably at the Lambe summer home last August 17. In addition to the hosts, those attending were Pam and Mickey Ligor, Eunice and Joe Schneider, Roz and Stan Margolin, Mary and Tom Toohy, Sonya and Frank Hulswit, and Nell and Fletcher Eaton. The committee got down to business after a two-hour period of serious meditation over steaks and other items of nourishment prepared by Harry and his good wife, Jean. **Stan Margolin** was authorized to run our 45th reunion in 1994 on the island of Bermuda. Stan and Roz have visited the island 50 times in the last 29 years, and the committee agreed unanimously that, af-

ter the stellar work the Margolins did for our 35th reunion there in 1984, it would be smart to let them do it again.

Avid readers of this column (bless you!) will recall that in October last year, I told of the super-sleuthing job done by Inez and **Marvin Zimmerman** in tracking down **Georges Diligent** in France. Now we hear from Georges himself that he is actually retired after 11 years in building construction, ten years as manager of a chain of movie theaters and 20 years as a farmer. The first two jobs were on the island of Guadeloupe in the French West Indies while the last was in Toulouse in the southwestern part of France.

The *Greek Sunday News* of May 14, 1991, reports that **George Hatsopolous** was a recipient of the 1991 International Award. Which international award is not revealed, but I am sure the organization is a prestigious one. Whatever its identity, its annually honors foreign-born individuals who have made extraordinary contributions to the United States.

Quoting from the article: "Technology has never had any secrets for Dr. Hatsopolous. As early as 1941 in German-occupied Greece, he secretly built transmitters for the underground as well as receivers for the Greek population. Once the war was over, his family, who had long played a role in developing technology in Greece, helped him move here to attend the Massachusetts Institute of Technology."

Following the receipt in 1956 of the ScD from MIT, "he soon founded the Thermo Electron Corp., a technology-oriented firm, which has now, 35 years later, become a giant conglomerate dealing in innovative technologies, particularly in areas such as energy conservation and environmental protection."

"Having served on the Board of the Federal Reserve Bank of Boston, the last two as its chairman, he is a member of the governing council of the National Academy of Engineering. He has written no fewer than 60 articles on subjects ranging from thermodynamics and energy conversion to cost capital and the international competitiveness of American Industry."

Chester Patterson writes from Costa Rica that he is still working in his businesses—manufacturing and machinery distribution and service. He is enjoying a great lifestyle and says, "Finally have the boat to go around the world but wonder, now, when or if to start."

An obituary in the *Cleveland (Ohio) Plain Dealer* tells us that **Ford E. Miskell**, 63, a sales engineer for the Envirotech Corp. of Cleveland, died of leukemia on June 24, 1991, in Atlanta, Ga. A native and longtime resident of the Cleveland area, he had moved to Hilton Head, S.C., after the death of his wife in 1987. He was treasurer of the Homeowners Association in Hilton Head where he enjoyed ocean swimming and sailing. During his years in Cleveland, Ford was a supporter of the Cleveland Museum of Natural History, the Holden Arboretum, and the American Field Service student exchange program. In 1955, he earned a master's degree from the University of Wisconsin, then joined the National Engraving Co. in Cleveland. Later he joined Bartlett Snow, a predecessor of Envirotech. He was a member of the Cleveland Racquet Club and the Playhouse Club. He is survived by a son, Jeffrey J. of Brookeville, Md.; a daughter, Kimberly Gerhardt of Houston; three granddaughters, and a brother. The class extends its condolences to Ford's family.—**Fletcher Eaton**, secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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John Bickford has recently retired as a VP of Raymond Engineering, Inc., and manager of its Power-Dyne Division. This summer he is teaching a short course in the Professional Development Program of the ASME. His course was "An Introduction to the Design and Behavior of Bolted Joints." . . . **Paul Masser**, who lives near Edwards

Air Force Base in Rosamond, Calif., would like to hear from classmates. He is especially interested in Technology transfer and new ventures, e.g., he has designed a world championship aerobatic aircraft and has obtained a patent on a high-efficiency air-conditioning system. In addition, he is doing aircraft reconstruction for fun and income. If you have similar interests, please contact Paul at 4201 Stephanie Ct., Rosamond, CA 93560.

Robert Roig, who now works for Mitre Corp. in Frankfurt, Germany, writes that he is well and enjoying good health. He would like to see more information in the class notes, but suspects that we tend to be a more private class. . . . **Robert P. Smith** retired last February as chief engineer for the Air and Space Division of Parker-Hannifin Corp. He plans to consult in his specialty, the design of Aircraft Bleed Air Valves, hopefully for far fewer hours per month than he has been accustomed to in the immediate past. . . . **Kier Finlayson** retired in 1986 as a physicist for the Picture Tube Division of RCA Corp. He is currently the managing editor of Technomic Publishing Co. of Lancaster, Pa. . . . **Thomas R. Keane** has been named a Du Pont fellow, the highest level of professional recognition of the company. He is the nineteenth Du Pont fellow and the second Du Pont Engineering employee to achieve this honor. His major field is in the area of reaction engineering. He is also chair of the International Symposium on Chemical Reaction Engineering. . . . **Francis Winiarski** has retired from the aerospace arena after 30 years at TRW space. He expects to remain in Palos Verdes, Calif., for the immediate future, polishing up his golf game, shaping up the house, and getting his youngest daughter started in college.

We regret to announce the deaths of two classmates. In May, **David I. Hellstrom** died in Framingham, Mass. Dave worked on the Boston Main Drainage Tunnel in the '50s. Following that assignment, he worked at the Army Corps of Engineers in Waltham, Mass. He then went with Arthur D. Little as a special consultant. He retired in 1988, but was still engaged most of the time as a consultant. Because of his previous work in tunneling in the Boston area, he was very helpful in the design of the waste water tunnels of the MWRA. . . . Later that month, **Grant Nason Macdonald** died in Niles, Mich. He was the retired general manager of Clark Equipment Co. of Buchanan, Mich.

Your class officers would like your thoughts on class activities for the next years prior to the 45th reunion in 1995. Please send any ideas or information about yourself to your class secretary. Your classmates are anxious to hear about you.—**John T. McKenna**, secretary, P.O. Box 376, Cummaguid, MA 02637

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At the May inauguration of MIT's new president Charles Vest, our immediate past class president, **Bill Maini**, marched in the grand procession as the representative of our class and of all of the alumni/ae of our decade

One of our most active alumni/ae in class functions, **Nick Badami**, informs us that his company, Ritangela Construction Corp., celebrated its 30th anniversary in June. The company was named after his lovely wife, Rita, and, at the time, their newly born daughter, Angela. Ritangela Construction is involved in heavy highway construction and, over the years, has been responsible for the completion of state highway projects in New York, New Jersey, and Pennsylvania. The company averages about 10-12 projects a year. Nick and Ritangela intend to continue in the construction industry with the same enthusiasm and dedication as when they first started.

After nearly 40 years in industry developing and marketing liquid and air filters, **Don Galinat** has retired from his position as president of Baldwin Filters. In doing so, he moved from the zero-

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degree temperatures of Kearney, Neb., to the 80-degree climate of Stuart, Fla. He spends his summers on the shores of eastern Maryland enjoying time with his eight children and 11 (shortly 13) grandchildren.

Babson College recently inducted **Amar Bose** into their Academy of Distinguished Entrepreneurs. In his acceptance address, Bose said that "people have an incredible ability beyond what we tap. You must believe in something to achieve it." He admonished those attending that they can be even more successful than those on the stage before them. Bose was accorded yet another honor when in May he was inducted into the American Academy of Arts and Sciences.

Discarding any retirement plans, **John Conley** as the director of worldwide sales and service of Lear Siegler Truck Products Corp. intends to extend their overseas business from 10 percent to a targeted 50 percent of their overall business. This has led to a lot of foreign travel in Europe, Mexico, and the Far East. He still has two of his four sons in school and believes that his youngest is targeting to go to MIT. . . . After selling his diesel engine business, **Edwin Richard** is pursuing a computer consulting business called P-C Resources. . . . Recognizing his efforts in "bringing the theater back to life with profound attention to detail and historical accuracy," **Bernard Rothzeit** was presented its 1991 award by the Preservation League of New York State.

The Knight Foundation, one of the nation's largest private foundations that makes grants in journalism, higher education, and the fields of arts and culture, has elected **Gerald W. Austen** as its vice-chairman. Austen is an internationally recognized heart surgeon and leader in studying the physiological events that occur during heart surgery and in the treatment of acute coronary artery problems. . . . Recognizing his pioneering work in the development of the Adaptive Linear Neuron, the Madaline Network, and the Widrow-Hoff delta rule, **Bernard Widrow** was awarded the 1991 IEEE Neural Networks Council Pioneer Award.

On a sadder note, **Eric A. Robba** passed away in March. Eric had been a supervisor of administration in nuclear construction and engineering at the Electric Boat Division of General Dynamics in Groton, Conn. In addition to his professional career, he served as the mayor of Groton following several terms as their town moderator. Our sincerest condolences go to his wife, Virginia, and others of his family.—**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368

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Last June, **Stanley Charm** received the 1991 DFSIA-ASAE food engineering award at the American Society of Agricultural Engineers' summer meeting in Albuquerque. (I can guess what ASAE stands for; if I knew what DFSIA meant, I would tell you.) Stan is a professor of biochemistry at Tufts who has worked on irradiation (of food, I suppose), blood rheology and flow, and drug residue testing in milk. He has founded a company, Penicillin Assays, Inc., to apply his work developing rapid antibiotic testing procedures. I regret to say that the company's slogan is "Nothing works like a Charm."

Allan Chin, as we told you a while back, sold out the company he founded and semi-retired to consulting for the radiation processing industry. He writes that he became a first-time grandfather last fall, and he highly recommends it. At about the same time, he founded a new company with his son, class of '82, to provide contract DNA sequencing services. I have no reason whatever to suppose that its slogan is "We lead with our Chins."

Benjamin Agusta of Durham, N.C., retired from IBM last summer after 35 years' service. We all know what IBM's slogan is, and I think I will let it go at that.—**Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301

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MIT recently reported on a conference at Tech, "Energy and the Environment in the 21st Century" held in March 1990. **Kent F. Hansen**, professor of nuclear engineering at MIT, was one of the organizers of this major conference, and he chaired a session, "Nuclear-Based Electric Power Technologies." . . . **George E. Dausman** reports that he is still working in the Secretary of the Army's staff as the deputy assistant secretary of the Army (Procurement). He is responsible for the total U.S. Army contracting program, \$30 billion per year of taxpayers' funds. He says these are all spent wisely and efficiently and he indicates there are no scandals in the Army. I suspect he has his hands full about now with the reductions in personnel and budgets that are going on throughout the DOD. . . . **Richard Lockhart** is residing in Greenfield, N.H., as of June 1991. He returned from Saudi Arabia a few years ago and has settled with his wife and son in the Monadnock hill country of New Hampshire, the region of his ancestors. The Lockharts are expanding their 200-year-old farmhouse, working the land, and getting involved with community farming, environmental affairs, and local planning.

I received a letter from **H.B. Christianson** of Sun City West, Ariz. He and his wife, Betty, moved there early this year. They like it there even though the temperature sometimes reaches 113 degrees. It used to be quite dry in Arizona when I was last there, and the high temperatures weren't as uncomfortable as the 90s are here in the Washington area, with our high humidity. H.B. indicates that he expects to see his fellow "Sloans" in October in Charleston, S.C.

A sad note, **James J. Mahoney** passed away in June of this year. He was a retired associate controller for the John Hancock Life Insurance Co. He lived in Needham, Mass., since 1952. At one time, he taught accounting at MIT. He is survived by his wife, Kathleen.

To finish on a happier note, think reunion, it is only 18 months until the 40th. We are still looking for volunteers in New England to work on the reunion committee. Drop me a note with your name and address, and **Marty Wohl** or I will get in touch. If you include your phone number, we might even call and be sociable. So long, until next time.—**Gilbert "Gil" Gardner**, secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

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We have very little news to report, and it is sad news. **Ray D'Arcy** died last June at his home in Oakland, Calif. Ray was a nuclear physicist with NASA. He had also worked for the Lawrence Radiation Laboratories and for Raytheon Co. Our sincere sympathy goes to his family.—**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Ln., Fairfield, CT 06430

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The March 4, 1991, issue of *Forbes* carried a very complimentary article on the Acorn Fund. This billion-dollar fund is managed by **Ralph Wanger**, a principal of Chicago-based Harris Associates. . . . In June, **Duwayne Peterson** was elected to a second five-year term on the MIT Corporation. Pete is leaving Merrill Lynch, where he has been an executive vice-president, and we understand he is returning to the West Coast. We look forward to hearing what he takes on next.

Although it is a lovely summer day as we write this, it is time to wish you happy holidays and to remind you that we need to hear what you are up to so we can pass the news on to our classmates.—Co-secretaries: **Roy M. Salzman**, 481 Curve St., Carlisle, MA 01741; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21042



At a cocktail party for the Class of '56 at MIT last June were (left to right) Howie and Marilyn Bertran, Ron and Lorraine Massa, Lloyd and Ruth Beckett, and George Brattin.

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In early June, the following classmates registered for the '56 warm-up reunion and/or Technology Day: Ruth and Lloyd Beckett, Marilyn and Howie Bertan, Charles Fink, Margie Gilson, Isobel and Gordon Kane, Lorraine and Ron Massa, Cassandra Perry, Lynne and Robert Sawyer, Geri and Rolf Wetzell, Nancy and Dick Jacobs. George Brattin attended the reunion warm-up cocktail reception and enjoyed the conversation.

C. Gordon Bell has co-authored *High Tech Ventures, the Guide for Entrepreneurial Success*. The publisher says it is "a necessary resource for every engineer, programmer, and high-tech manager." . . . The most concise class note award from this columnist goes to **Howard Bertan** who writes, "Doing good." . . . **Kreon L. Cyros** is still enjoying his work as director of MIT's Office of Facilities Management Systems. They are doing some exciting development work with work station database and PC-based CAD/GIS systems. Their technology transfer efforts in sharing these systems have now led them to European universities and medical centers in addition to those in North America.

Irwin Dorros, executive vice-president for technical services at Bell Communications Research (Bellcore), received the IEEE 1991 Founders Medal "for distinguished technical leadership in the evolution of national telecommunications networks and the implementation of a major R&D resource." Irwin is an IEEE Fellow, a member of the Columbia University Engineering Council, the Board of Overseers of New Jersey Institute of Technology, and the National Academy of Engineering. He holds five patents and has published numerous technical articles on telecommunications. . . . **Martin Jacobs** is chairman of the Trustees of Action on Smoking and Health (ASH), a non-profit legal-action organization founded by John Banzhaf, III, '62. Martin is a senior staff analyst with the N.Y. Merchantile Exchange. Martin and Joyce live in Teaneck, N.J., with their younger son, Michael. Their older son, Daniel, is studying public policy at the University of Chicago.

Charlie Joyce sold his telecommunications consulting firm in 1988 to Ernst & Young, where he is the E&Y partner responsible for the information systems Technology Center. . . . **Ben Lightfoot** has taken early retirement from Northwest Airlines, where he was vice-president for maintenance and engineering for 11 years. In October 1990, Ben received the Air Transportation Association's "Nuts and Bolts" Award for his contribution to the airline technical operations and to the aerospace industry. He remains a member of the NASA Aeronautical Advisory Committee and is active in aviation consulting work.

We regret to inform the class of the passing of **Adolph J. Hansen**. He is survived by his wife, Pauline, of Hastings-on-Hudson, three children, and two grandchildren. He may be remembered through Hastings Helps the Hungry, Hastings Volunteer Ambulance Corps., or the American Diabetes Association.—Co-secretaries: **George H.**

Brattin, 39 Bartlet St., Andover, MA 01810, (508) 470-2730; **Irwin Gross**, Sweets McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

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Please send news for this column to: **John Christian**, secretary, 23 Freddana Rd., Waban, MA 02168

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First off, we need to make a correction to last month's class news in which some information in the middle of the column was omitted. Fortunately, we were able to find it before it was "lost forever 'neath the streets of Boston." **Fred Davis** is not living in Bangkok, as his family and friends in Annapolis will be relieved to know! Fred was, however, selected associate dean for academic affairs at the U.S. Naval Academy beginning in August 1992. Currently, he is professor of mathematics at Annapolis. His wife, Kathy, is a clothes designer and a writer for *Threads* magazine. Their daughter, Cindy, is a manager for Anderson Consulting, and Liz is finishing her third year of medical school at Johns Hopkins, specializing in cardiac surgery. . . . So, if Fred is not in Bangkok, then who is the mystery person we reported as living there? Why, none other than **Sawad Wattanayagorn**, of course! For those traveling to this part of Southeast Asia, Sawad writes that he would be "very glad to be of help to classmates who happen to drop by Bangkok. Currently, I am serving as deputy permanent secretary (Deputy Undersecretary of State) with the Ministry of Agriculture. Our offices are located at Rajdamern Nauk Ave. in Bangkok."

Now to this month's news. **Richard Finn** was appointed as a project manager in the MIT Department of Physical Plant this past spring. Previously, he held positions with the Perini Corp. and with Erland Construction in the Boston area. . . . Received word from **Walter Braun** that he is now a senior scientist with RDC in Greenbelt, Md., where he is working on NASA-related programs.

Clayne Yeates, who passed away this spring, was posthumously awarded NASA's Outstanding Leadership Medal for his work at Jet Propulsion Laboratory on the Galileo spacecraft. Most recently, Clayne served as science and mission manager for the project, one that he had been associated with since 1977. He had joined JPL in 1968 after receiving a PhD in plasma physics from BYU. Many of us will remember Clayne's singing with the MIT Logarithms. We extend our sympathy to his wife Laurie and his children.

Paul Knopf is professor of medical science at Brown University, and he is also serving as chairman, Section of Molecular, Cellular, and Developmental Biology. Paul and Carol are living in Barrington, R.I. . . . **Francis de Winter** is the editor of a new book, *Solar Collectors, Energy Storage, and Materials*, published by the MIT Press. . . . **David Baldwin** has returned to the Lawrence Livermore National Laboratory as associate director for Magnetic Fusion Energy. For the past three years, he had been director of the Institute for Fusion Studies at the University of Texas in Austin. Previously, he had been at Livermore since 1970 in several positions involved with magnetic fusion programs.

We got a note from **Mel Copen** telling us that he is on the move again: "After four years as rector of INCAE and living in Central America, I will be moving to Japan to assume the deanship of an International MBA program started by the International University of Japan with the assistance of the Tuck School of Dartmouth." . . . Well, having solved "The Mystery of the Missing Missive," I'll be out until next month.—**Mike Brose**, secretary, 1619 Greenleaf Blvd., Elkhart, IN 46514

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Please send news for this column to: **Allan S. Bufferd**, secretary, Office of the Treasurer, MIT, 238 Main St., Suite 200, Cambridge, MA 02142

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This is going to be a short column, as I can only write when I hear from you folks, and I haven't heard much.

Thomas Christy came by my Pentagon office recently and left a note saying that he has signed a contract with the Piney Orchard Ice Arena to buy ice time for a senior men's ice hockey group he heads. The arena is in Odenton, Md., and is the same one used by the National Hockey League's Washington Capitals as their practice rink. Tom says the facilities at Piney Orchard are first rate and he urges '60 hockey enthusiasts to give him a call at (301) 394-1983, as he occasionally has an opening for a skater or two. Tom skates defense, but says he also puts on the goalie pads when one of his goaltenders cancels on short notice. (One of Tom's stalwarts on the ice is Fred Rhinelander, father of *Technology Review* staffer, Alexandra.) When not on the ice, Tom is on the staff of the U.S. Navy's Surface Warfare Center.

Robert Wolf writes from Claremont, Calif., that, after serving four years as director of Academic Computing for Harvey Mudd College, he has returned to full-time teaching and research in physics. He celebrated the return with a sabbatical divided between the ESIEE in Paris and the University of Hawaii. Bob says that he is looking forward to developing computational physics as a third field to complement experimental and theoretical physics.—**Frank A. Tapparo**, secretary and class agent, 15 S. Montague St., Arlington, VA

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Please send news for this column to: **Andrew Braun**, secretary, 464 Heath St., Chestnut Hill, MA 02167

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30th Reunion

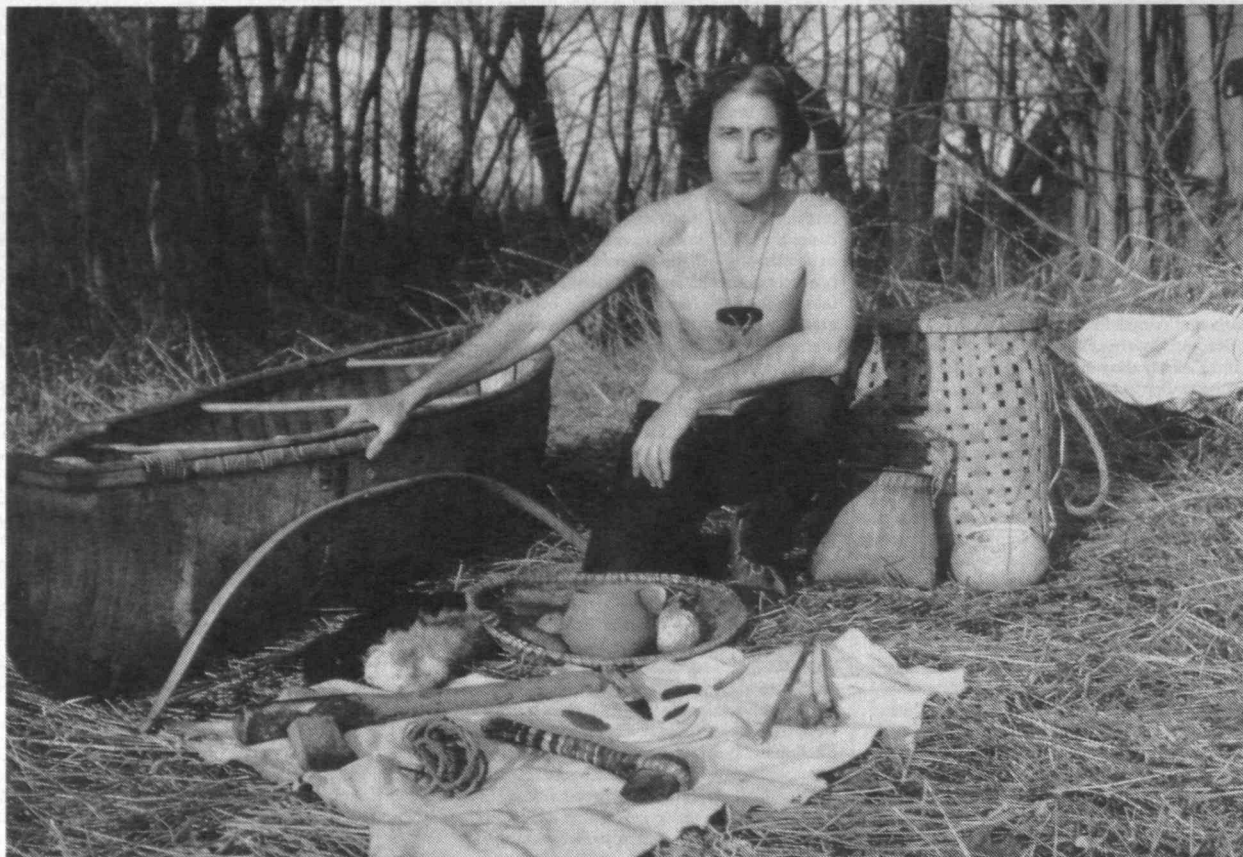
John Rollwagon was in the news again with a picture of John sitting on a Cray console on the first page of the Business Day section of *The New York Times*, Monday, May 6, 1991. Cray's main competitive challenge is the super-fast microcomputers that can operate at about half the speed of the Cray, but at 5 to 10 percent of the capital cost. Cray intends to respond by "leveraging hundreds of microprocessors, a technique known as massively parallel computing."

George E. Ioup, is currently professor of physics and geophysics at the University of New Orleans. George also serves as the director of the UNO Center for Energy Resources Management and as director for UNO at the Stennis Space Center in Mississippi.

Speaking of professors, yours truly, **Henry N. McCarl** was recently promoted to full professor of economics and geology at the University of Alabama at Birmingham. Hank also serves as the director for the UAB Center for Economic Education, an affiliate of the national Joint Council for Economic Education, headquartered in New York City. . . . **Bardwell C. Salmon**, known to his classmates as "Bojey" but aka "Bard," (I guess he always liked Shakespeare), writes that he and his wife, Cindy, became grandparents for the first time this spring. Their daughter, Cheri and husband, Jeff, delivered their grandson, Christopher William Gordon in May 1991. He observes that all is well except the New England economy.

John Cervanka, MD, writes: "I am staying busy with a full time schedule in our local medical clinic and weekend work as an emergency room physician. I will serve as chief of staff of our

Paddling Upriver Through Prehistory



This was not just the beginning of an ordinary canoe trip. As a boy of 12, I had dreamed of such a voyage. . . I might have undertaken it at 20. . . but in the intervening years I had developed an unquenchable passion for knowing, in a most fundamental way, who I was and what it was that made me so.

At the age of 40, James Dina, '68, decided that building a birchbark canoe with Stone Age tools and paddling up the Connecticut River to its source would be his vehicle to enter the world of the past—his route to the answers he sought. He spent two years making preparations—gathering the materials and assembling the canoe, learning what foods he could forage along the way—and then in the summer of 1984 began his voyage.

Dina describes his journey of discovery in *Voyage of the Ant*, written in a birchbark wigwam he constructed on a hill overlooking the Connecticut River near his home. "Limiting

myself to the tools and materials available to primitive Americans would require me to discover ways of thinking and doing that had disappeared centuries ago." Dina conjured up the qualities he imagined his enterprise would demand by painting an ant, a symbol of patience and perseverance, on the headboard of his boat.

Nautical life and technology were not new to Dina. He received an engineering officer's license from the Merchant Marine Academy in 1964, and sailed around the world for three years, tending boilers on ship. In 1968, he completed an MIT degree in mechanical engineering, specializing in heat transfer, and landed a job with Combustion Engineering in Windsor, Conn.

The traditional industrial job didn't last long. Spurred by an early love of music, Dina decided to study classical guitar, and he received a music degree from the Hartt Academy in 1972. He had settled in South Wind-

sor, with the river in his backyard, teaching music in the schools and to private students. But that didn't quite satisfy him, either.

"Certain small things about modern life always annoyed me. I couldn't tune up my car anymore; an engineering degree from MIT wasn't enough without another thousand dollars worth of sophisticated equipment. . . The maxim 'simple tools for simple tasks' was fast giving way to a preoccupation with intricate solutions." It wasn't that he didn't understand modern technology. The problem, explains Dina, was that, "I was losing control over things that affected my everyday life, and with that, I was losing a little of my personality."

That's when he embarked on the canoe project, which would be totally dependent on his own resourcefulness. He started by reading books of Indian lore, but the "how to" details were missing. "At last it dawned on me that no living writer or speaker had ever built or remembered seeing

anyone else build a birch canoe with Stone Age tools. . . . Somewhere, sometime, some primitive boat builders had come up with the design, materials, and methods for creating the birchbark canoe. There was no tradition that dictated their choices. Right now, I found myself in their same position. . . . I needed to think about the wood itself. What must it be like? What must it do?"

Unlike a canvas canoe, a birchbark canoe is built from the outside in. So Dina's first task was to locate the right tree—large, straight trunk; a 12-foot section without a branch; resilient bark. Using a stone ax, he cut saplings for a ladder that enabled him to make one vertical cut through the bark with a flint knife. Then with an ash splint, he lifted off the bark in one 12-foot section and put it in his neighbor's pond to soak. He would need two such sections of bark for the watertight shell.

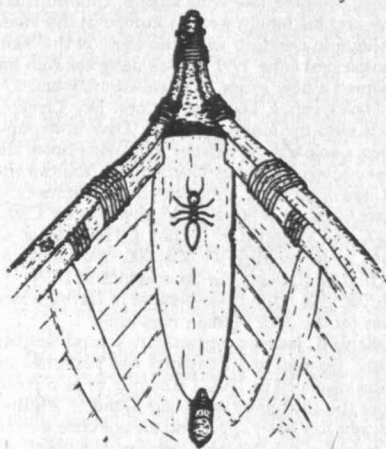
Historically, cedar was used for gunwales, inwales, and ribs, but it was no longer available. So Dina determined that ash had suitable properties. He removed splints from the tree by pounding the bark and prying them loose with a flat bone. He needed a container in which he could steam the ribs into shape, so he had to rediscover the technology of making clay pots. He used pine roots to sew the pieces of bark together and pine pitch to make a watertight seal.

"I started out with the idea that my body was the technology I had at my disposal and extended from there. In the beginning, I felt technologically naked, but by the time I finished making stone tools, I didn't feel so much that way. By the time I was on the river in a birchbark canoe I had made, I felt that I had what I needed."

Dina identified 13 food and medicinal plants that were readily available in his area, and he hoped to find them as he progressed upstream. He brought stores of dried meat and corn in a birchbark container—Indians found they could even bury such containers of provisions, because rodents don't like the taste of the bark. He foraged for groundnuts, picked lamb's quarters (also called goosefoot or pigweed), fished from the river using handmade bone hooks, and drank willow bark tea to ease aches and pains. He fashioned several cooking pots with his primi-

tive pottery techniques, and used gourds and a birchbark canteen for storing liquids. Unfortunately, he forgot a supply of salt, but he did bring maple sugar treats that he had harvested from a tree in his yard.

Voyage of the Ant is also full of the river's history: the Maricans, Quirepeys, Makinanes, Sequins, Nawaas, and the Horikans, the earliest known inhabitants of the region; the Dutch Captain Block, who in 1614 was the first European to explore the Connecticut River and was met by Horikan Indians in birchbark canoes; and Outpost Four, the westernmost protection for the British settlers and a base from which a raid was launched during the French and Indian Wars. But he did not exclude the 20th century: his



discussion of energy deals with a nuclear plant on the river as well as hydropower, and motorboat enthusiasts appear in his book along with more traditional boaters.

Dina captures the intimate way that the beauty of New England unfolds: "The backroads reveal only a little at a time and that is their secret. Just as with the river, one never knows what will be around the next bend . . . a shuttered cottage with its husband and wife spruces sheltering the entrance; a stony pasture . . . a simple white church, as austere as the people who carved homes of the wilderness. The deepest beauty lies in the detail, in the subtleties."

Edna and Bill live at just such a bend in the river. In search of water, Dina arrived at their door as a family gathering was breaking up. Edna decided that his clothes could use a wash, so she gave him a pair of Bill's trousers to wear and headed off with the laundry. While Bill and Jim Dina

sat on the porch of the house where Bill has lived since 1900, they ate the cake Bill baked and talked about the days when the porch looked out on traffic headed for a toll bridge, long since abandoned. At 92, Bill advised, "You got to keep busy to stay young. Bakin's done just fine for me."

"I chose a project that had a good chance of doing me in," Dina admits. Having vowed to himself that he would never go backward, he fought the three-knot current upstream. If he encountered a head wind, he'd make for shore to wait it out. The first summer, he went as far as Bel lows Falls and returned content. Over the following winter, he decided to complete the journey to the source.

In the summer of 1985, struggling over portages and nearly losing his canoe in the sudden release at a dam, he finally arrived in Bloomfield. The water is too shallow to continue, the locals told him, and besides, though the Connecticut is longer, the Nuthegan branch is more historic. (It was the route in the aforementioned attack on the French.) Determined but realistic, Dina stored the canoe in Bloomfield and hiked the rest of the way across the Canadian border—the last of the Connecticut's 500 miles.

Looking back, Dina understands better who he is: his character is indeed like the ant, having tenaciously carried through his plan. In trying to answer his own questions, Dina's book takes readers beyond the step by step evolution of human history and invites them to explore the metaphysical dimensions of our nature where, on the one hand, we can survive moment to moment as the ordinary beast; and, on the other, soar godlike in the realms of dreams, and actually achieve them.

Now an expert in ancient lore, the Windsor music teacher gives talks about Native American crafts and shows visitors his work, including bark and cattail wigwams. And don't believe anything you may have read about birchbark canoes lasting only four or five years. Dina says his seven-year-old canoe is good for several more seasons.—*Susanne Fairclough* □

James Dina's book, Voyage of the Ant, was published in 1989 by Stackpole Books.

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Richard Dattner FAIA, '60

hospital in 1992." Now if we just had a postmark or some clue to the location of all this medical activity, I could tell you if John is practicing in Boston, New York, Chicago, Singapore, Tokyo, or somewhere in between. Classmate Bjorn Qvale, a resident of Rungsted Kyst, Denmark, and professor at the University of Denmark, Lyngby, has been named a Fellow of the American Society of Mechanical Engineers (ASME). Bjorn was a member of our entering class and graduated with both an SB and SM from Course II in 1963, and a PhD from the same department in 1967. The honor of Fellow of ASME was awarded to Qvale as a member with at least 10 years active engineering practice who has made significant contributions to the field.

George C. (Chris) Pedersen writes: "Since founding Kimre, Inc., in 1974, we have been developing the technology and product range. Kimre has become a worldwide supplier of mist eliminators, tower packing, drift eliminators, and multi-stage aerosol separation systems primarily for state-of-the-art air pollution control technology." Given all these activities and methodologies it seems that Chris might challenge Arnold Schwarzenegger for the title of Eliminator II.

Mary and I visited Dave Stare's Dry Creek Vineyard in Healdsburg, Calif., in June 1991. We especially liked the flower and vegetable gardens, and enjoyed the fine wine tasting. Unfortunately, Dave and his family were in Europe at the time. We hope to catch up with him again at the 30th reunion next June 1992. Dave's daughter Kim has designed a new series of award-winning labels for Dave's wines. Look for the new Dry Creek labels with the familiar sailboat. Dave now publishes a quarterly newsletter with wine notes and great recipes for things like chutney. You can find out how to become a member of the Vintner's Select Club, by writing to: Vintner's Select Club, Dry Creek Vineyard, P. O. Box T, Healdsburg, CA 95448, or by calling (707) 433-1000. You can even reach Dave through the fax machine at (707) 433-5329. We hope to have some of Dave's wines again for the 30th reunion next June.

Leland B. Jackson writes: "My second textbook *Signals, Systems, and Transforms* was published by Addison-Wesley in 1991. I continue to be a professor at the University of Rhode Island."... Philip Cassidy has been appointed an associate technical fellow of the Boeing Company. His wife, Kathie, was an administrative assistant for the recent Billy Graham Crusade in Seattle, and sons, Sean and Edward, are both mechanical engineers. Scott L. Danielson who received his BArch in '62 and MArch in '67, has been elected a vice-president of Parsons, Brinckerhoff, Quade, & Douglas. He had served as technical director of architecture for the firm for eight years. He has supervised the completion of ten rapid transit stations in Singapore, directed design concepts for 70 stations in Taipei, and recently finished a feasibility study for a \$3 billion resort village in Japan. Scott's work evolved from the multi-disciplinary studies he did at MIT "Project Metran" in 1966. He has worked on over 400 transit facilities since graduation from the San Francisco Airport to his work in Singapore, Taipei, and Japan.

We are always looking for news concerning our classmates. Please drop me a line whenever you have the opportunity: Hank McCarl, secretary, P.O. Box 352, Birmingham, AL 35201-0352

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Summer doldrums are here again. (I'm writing this in early August!) I have just one note—but an interesting one—from Henry Nau. He has a new book, *The Myth of America's Decline*, published by Oxford Press, and it will be out in paperback and in Japanese in the winter. From what little I have heard about the hardback, it's a real eye opener and well worth reading! Uhhh... that's all folks. Write, phone, send e-mail, communicate, please.—Phil Marcus, secretary,

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(301) 750-0184, CompuServe 72047.333, Internet:
72047.333@compuserve.com.

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And yet again, it is necessary to begin the column with news of the passing of a classmate. John Drummheller died on February 8, 1991, at the age of 49. He leaves his wife, Betty, a son, Bill, and a daughter, Cori. At the time of his death, he was living in Issaquah, Wash. No other information is available at this time. I'm sure that all of you join me in expressing our sincere condolences to John's family.

The *New York Times* and the *Wall Street Journal* both carried news of a move made by Laurence Hootnick. He left Intel Corp., where he had been president of the Controller and Memory Group, to become president and CEO of Maxtor Corp. in San Jose. Maxtor is a supplier of high-capacity, high-performance data storage products. . . . David Morrison writes that he has spent since last May as fire chief, though he did not say where. He is curious to know if any other class members are in fire departments or emergency medical services organizations. . . . Chris Ritz sends a brief letter with some career news. After 15 years in management science consulting, specializing in marketing and logistics strategy, he has accepted a position on the visiting faculty at the Wharton School of the University of Pennsylvania. Starting in the 199-92 school year, he'll be teaching in their MBA and executive MBA programs.

James Chang saved up 27 years worth of news and sent a letter, most of which follows. "I've been married to my wife, Victoria, for the last 24 years, and we are looking forward to our silver anniversary. I have two daughters; the oldest, Melissa, is beginning her sophomore year at Harvard. My younger daughter, Allison, is consuming all my free time this summer with college visits, as she will be entering her senior year in high school and applying for college in the fall. My family has been living in New York City for the past 15 years and in all likelihood will be here for many more years despite all the quality of life issues that are becoming more difficult to deal with as the years go on.

"Professionally, I am currently an associate clinical professor of radiology at New York University School of Medicine and a Fellow of the American College of Radiology. Following completion of medical school, I did a residency and fellowship in diagnostic radiology and angiography. I spent one year at Long Island Jewish Medical Center and then moved to St. Vincent's Hospital and Medical Center of New York as section chief of angiography and interventional radiology. Currently, I am the vice-chairman of the Department of Radiology and head our 17-member radiology group that services the hospital and its teaching program of 16 residents.

"In the last six years, I've gotten much more involved with the political and socio-economic aspects of medicine, particularly with respect to radiology. I'm currently the president of the New York State Radiological Society and councilor to the American College of Radiology. Unfortunately, neither my medical school training nor education at the Institute prepared me for dealing with politicians, lobbyists, legislators, regulatory agencies, bureaucrats, and hospital administrators. These activities probably consume at least half of my time, giving me little opportunity to practice radiology or be involved with our resident teaching program. Although I long for the 'good old days' when I was a 'real' radiologist, I believe the circumstances of the time dictate the need for physicians to be involved with non-academic and non-clinical aspects of the profession of medicine."

Please take the trouble to follow the lead of James and write a letter with your news.—Joe Kasper, secretary, RR2, Box 4, Norwich, VT 05055

Saw **Dave Driscoll** at Draper Laboratories recently. Dave worked at the Office of Sponsored Research at MIT after graduation and went to Suffolk University Law School on the side. When Draper was established, he went with them to help provide administrative management and has been their CFO for years. Dave lives in Winchester, Mass., and is the father of three children, two currently attending Vanderbilt University. . . . **Alan Mitchell** writes from Bellevue, Wash., that he is managing software engineering for BBN Advanced Simulation there. They develop visual systems.

Enjoyed talking with **Mary Coffey** recently. Mary is now working in a PG&E/Bechtel joint venture in cogeneration, focused on the permitting area. After getting a master's in astrophysics at the University of Colorado, she got a PhD in environmental health from Harvard and spent nine years working for Nuclear Utility Services before joining Bechtel. In her spare time she likes to hike and has begun becoming a serious bird-watcher. She reports continued contacts with **Nancy Wood** and **Sharon Ross**.

Paul Blumberg, president of Ricardo-ITI, was named a fellow of the Society of Automotive Engineers for his work in the development and application of cost-effective, computer-based design and analysis methods for internal combustion engines and powertrain systems. Paul founded his company in 1983 and sold it to Ricardo in 1988. He and his wife Harriet have three children, Ilana, Jonathan, and Naomi, ages 14-20, and live in the Chicago suburbs. . . . **Ken Marsh** reports he is currently living in Chelmsford, Mass., with his wife Genevieve and children Nicholas, 10, and Noreen, 6. Ken is VP of R&D at Thornton Associates in Waltham.

In other news, **John D.C. Roach** left Manville Corp. to join Fibreboard in San Francisco as chairman, president, and CEO. The announcement in the *Wall Street Journal* highlighted the stockholder and board dissents over the company's actions, so I'm looking forward to hearing firsthand how J.D. holds out.—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

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As a class, we owe **Jeff Kenton** a round of applause for being class secretary for the last ten years. The class has now turned this job into a rotating position. In the transition we missed the deadline for the last issue and news of the 25th reunion. Those of you who attended enjoyed perfect weather, lots of reminiscing, exquisite food, stimulating programs, the presentation of the class gift, and a *sack hop in the gym!* We can't let it pass unnoted that 60 percent of the alumnae from the class attended. (Just to give the male members of the class something to shoot for for the 30th.) **Donah Zohar** (**Donna Hayes**), who is a very published and well-known author, came all the way from England. . . . **Betty McKenna** is president of a computer consulting firm in Texas. Her daughter, Amy, will be in the class of 1995. Joining Amy in that class will be Mark Urmacher, the oldest son of **Barbara Pollack**. Barbara continues to work in the consulting company she and husband Carl started in 1980. Their two new sons were also at the reunion.

Lucy Garnett is a mathematics professor at Baruch in New York City. Setting a record for stability is **Muffet Shork Chatterton**. She and Howard have lived in the same house in Bowie, Md., since leaving MIT. Muffet has worked for the Nuclear Regulatory Commission about that long. They celebrated their 25th wedding anniversary by traveling to Ireland right after the reunion. **Paula Jacobs Brooks** and **Mona Dickson Jensen** have both stayed in the Massachusetts area and are both in the medical instrumentation

field. Mona is a senior research and development manager for a medical instruments company, while Paula is vice-president of Advanced Magnetics in Cambridge.

Three of the alumnae came from California. **Barrie Skinner** is the director of semiconductor equipment for a Japanese firm there. Her daughter, Nicole, '90, was able to join us. . . . **Barbara Coulson Kurtin** is a materials engineer for an aerospace firm, while husband, **Steve Kurtin**, is an inventor and president of his own company. . . . **Andrea Sebera** is a strategic software planning manager for space systems. As for me, I received an MBA from the University of Buffalo in the spring but am back at school this fall to take my last required courses. I am now studying for the CPA exam. **Bill Klepser** is a project manager with Keller Technology and gets to visit very interesting places. He flew in from China for both the reunion and our daughter's graduation from MIT.

In other news. . . . **Patrick Lee's** name popped up in a variety of articles. Lee, who is a William and Emma Rogers Professor of Physics, was elected to the American Academy of Arts and Sciences and the National Academy of Sciences. He is noted for his work in condensed matter theory. Also elected to the National Academy of Science was **Francis DeSalvo**, a chemistry professor at Cornell University.

Robert Wolf sent a letter to **Carl Jones** summarizing his last 25 years in just a little over two pages. After grad school at Stanford, he taught in a variety of colleges, settling at Cal Poly in 1975. In addition to his 12-hour teaching load, he is chairman of the Cal Poly "Fairness Board," kind of a student ombudsman. He has a son, Aaron, four cats, a snake, and a wife, Diane, who is also a philosophy professor. He plays a lot of tennis, is studying bongos (instead of piano), and is involved in a lot of "causes," most recently Earth Day coordinator for two weeks of activities. He also mentions that **Marty Kaliski**, his wife, four children, and many cats, came to California from Boston about four years ago, and Marty is now chair of the Electrical Engineering Department at Cal Poly.

Paul Eckstein, MD, writes that he is part of a group of cardiac surgeons who have the largest heart transplant program in Florida. He was recently elected to the International Society for Cardiovascular Surgery. He has four children and a wife, Sue, who has just received a master's in counseling. . . . **Wayne Stevens** notes that he continues to work for IBM in computer software development methods and tools and was responsible for a volume of Prentice-Hall's new series on software development. His son, Russell, graduated from MIT in 1991, and his daughter, Wendy, is a sophomore at U Mich. We must have all really loved our MIT experience to send so many of our children.

I do have a pretty large backlog to use for future columns, but in this case no news is not good news. So do keep writing.—**Eleanore Klepser**, secretary, 84 Northledge Dr., Snyder, NY 14226

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25th Reunion

Reunion News has been very sparse lately, so please write.—**Jim Swanson**, secretary, 878 Hoffman Terrace, Los Altos, CA 20818

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Please send news for this column to: **Gail and Mike Marcus**, co-secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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First we hear from another granite-stater, gentleman-farmer **Robert K. Wiener**, who lives to the east and a bit closer to the coast than I. Bob

writes: "I've been very happy in southern New Hampshire the last three years. I have over 150 apple trees, two beehives, and a new 32 by 76-foot barn. In August we'll be publishing the new Stephen King book, *The Dark Tower III: The Waste Lands*, in a limited hard-cover edition." . . . Another fellow in the paper trade, **Rexford A. Stark**, is still plying his art as an antique dealer who specializes in mail-catalog sales of historical Americana. . . . **Kathryn K. James** writes from Annandale, Va., "I recently went to my 25th reunion from Hunter College High School (class of '66) and saw Laurie Nisonoff (MIT class of '70). Hunter has contributed several coeds to MIT over the years and is probably now contributing male students since it is now coed."

David Jodrey claims to have begun "a new phase in my existence." He is now postdoctoral fellow in health psychology, in the Division of Occupational Health, in the Department of Environmental Health Sciences of the Johns Hopkins School of Hygiene and Public Health. David observes: "I've spent all my adult life in areas, broadly construed, that began with B—Boston, Buffalo, Backwoods Virginia, and now Baltimore." . . . If I have already mentioned this great honor, it is a pleasure to repeat it: **Mark Davis**, professor of astronomy and physics, and chair, department of astronomy, University of California, Berkeley, is one of 60 new members of the National Academy of Sciences.

Vincent G. Mace has been elected senior VP and group actuary by Chubb Life America in Concord, N.H. . . . In 1989, **George L. Claffen, Jr.**, completed six years as chair of the division of architecture at Temple University. He has spent the last two years writing, practicing, and teaching. . . . My *Fire from Ice* continues to garner excellent reviews as it stirs controversy about the essentially incontrovertible. Having resigned from the MIT News Office in June, I still continue to teach the Science Journalism course at the Institute. I have also been working as a consultant to industry, lecturing across the country on the hot topic of cold fusion, and pursuing a well-nigh infinite literary project: "What happens next—the saga continues."—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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Steve Oreck sent us a letter after he returned from the front, that is from Navy Fleet Hospital 15 off Saudi Arabia and Kuwait. "I've been very busy in my hand and microsurgical practice here in New Jersey [Central Jersey Hand Surgery P.A.], which has now expanded to include a total of four physicians. We've been doing active clinical research in better ways to treat tendon injuries. The paper we are getting together on that, however, was delayed by my four-month return to active duty, most of which was spent in the Persian Gulf as an orthopedic surgeon with a Navy fleet hospital. During this period I also got up to Kuwait, where I was detached as a medical officer for an explosive ordnance disposal detachment in Kuwait City and got to see a lot of the oil fires and other damage at close range. You can tell all the readers of *Technology Review* that the television pictures simply don't do it justice and that the destruction of the environment in the coastal region where it's not total sand dune desert, but what's known as scrub desert, is fairly extensive, with all the vegetation in the oil-fire areas as well as much of the wildlife being killed off or driven off. Anyway, I'm back at work and also doing some informal consulting on various projects involving computerized and automated evaluation of hand function." Steve also reports that his sons Greg and Brian have graduated from high school and eighth grade, respectively.

J. Strother Moore received the 1991 Current Award for automatic theorem proving from the American Mathematical Society. He received the award for the construction and application of a computer program to help verify that other com-

puter programs meet their specifications and to verify mathematical proofs. J is currently at Computational Logic, Inc., a company he helped found in 1983 in Austin, Tex., where he was a professor in the Department of Computer Sciences at the University of Texas. He and Miren Carranza have four children: Lisa, Nicholas, Jonathan, and Natalie.

Richard Nagy writes: "With the current slump in defense-project funding and 'right sizing' access in industry, talks of weekend plans and holiday trips are replaced with speculation of project/business continuance during social times. What a change from the '80s boom times! Still employed, though (today)." . . . **James Patell** has gone back to being a full-time professor at the Stanford University School of Business, giving up his associate dean duties.

Charles Lieberman reports that he has been with Manufacturers Hanover for five and a half years, the longest he has managed to be at a single job. Let's hope that the merger of Manufacturers Hanover with Chemical Bank does not end that record. His oldest son David entered high school this fall, son Michael entered junior high, and youngest son Jeremy began second grade. His wife Ann (Bryn Mawr '70), as Charles put it, "continues to do good as a social worker."

Lou Zarfas tells us he is "still working in the Design Group at the United States Patent and Trademark Office. Just started my second four-year term as editor-in-chief of *The Journal of the Patent & Trademark Office Society*. Using my wheelchair more regularly now as my M.S. progresses. My wife, Jane Edwards, has a burgeoning new career as desktop publishing teacher and consultant. Our kids, Katherine (11) and Davis (9), are keeping busy with sports and scouts and are still on the honor roll. I'd better start saving up in case they want to go to my alma mater."—**Greg and Karen Arenson**, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

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Peter V. Hwoschinsky was recently promoted to technical manager of FAA's Vertical Flight Special Program Office. He and his wife, Beth, who works for the CFO for Martin Marietta Corp., live in Herndon, Va. . . . **Bill Charles** writes: "Our two-year-old, Ean (aka "Treelegs"), has learned to climb the pantry shelves to get to the cookies. We're taking him on vacation in July for four weeks of walking, swimming, boating, and shopping. I am still trading futures and options while trying to stave off physical decline and hair loss with diet and exercise—to no avail. Wife Kathleen is busy as ever with us and an occasional investment consulting job."

Leslie Lynn Rahl, founder of the interest rate cap, collar, and floor business and former head of Citibank's interest rate risk management department, has formed Leslie Rahl Associates, a consulting firm that will specialize in interest rate, currency, equity, commodity, and municipal swaps and derivative products. Her firm is the only consulting firm dedicated to the rapidly growing \$3 trillion dollar swaps and derivative business. After receiving an SB in computer science from MIT, she received an MBA from the Sloan School and attended a special program on marketing management at Stanford. She has been extensively interviewed as an industry expert and has been widely quoted in *Euromoney*, *Institutional Investor*, *Fortune*, *Barron's*, *Corporate Finance*, *Risk*, *Corporate Risk Management*, the *New York Times*, and many other publications. She was featured in *Institutional Investor's* "The Next Generation of Financial Leaders" and appeared in *Fortune's* "On the Rise" column.

Frank St. Claire and **R. Hal Moorman**, both Texas attorneys, have been appointed to the Council of the State Bar of Texas Section on Real Property, Probate, and Trust. . . . Please send me your news.—**R. Hal Moorman**, secretary, P.O. Box 1808, Brenham, TX 77834-1808

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Only one note this month. **Andrew Moysenko** writes that he is manager of independent research and development at Lockheed Sanders in Nashua, N.H., a member of the MIT Educational Council, and past president of the Northern New England Chapter of the Institute of Environmental Sciences. . . . To fill this space next month, write to Wendy or me.—**Dick Fletcher**, co-secretary, 135 West St., Braintree, MA 02184

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Carl Wieman writes for the first time in ages. He received a PhD in physics from Stanford in 1977 and is currently married to another physicist, Sarah Gilbert. He is now a professor of physics at the University of Colorado-Boulder and a fellow of JILA, doing "stuff with atoms and lasers." Carl's first extended visit back to Cambridge was this past spring, giving the Loeb lectures at Harvard.

Ronald Gittelson writes from Switzerland, where for five years he's been with the International Air Transport Association helping their move toward OSI computer communication standards. Ron is married to Margrit, with whom he has two children, Simone and Claude.

On the home front, my own two, Eric and JR, are heading into their senior and fifth grade years, respectively. I look forward to a repeat of the college application process these next few months that I enjoyed (ugh!) 23 years ago. Ruth has gone back to the work force as the leading saleslady for a bridal shop in Manassas. I now know that dressing brides is more exhaustion than exuberance. Your truly is still at PRC as a program manager, helping the Marines move data around the world. Life is too short not to keep your classmates apprised, friends. Write.—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

74

Your faithful scribe almost didn't set his words into type this month, owing to the scarcity of news. Then it occurred to him that in a short column he could have room to make an extended plea for notes and things from your most faithful readership. All it takes is a letter, a stamp, and some time. I'm sorry I don't have an electronic mail address. I do have a telephone with a bright, crisp, answering machine. Do not worry about making your news interesting. It's interesting to me, and it's my job to make it interesting to other people. Some things to include: your spouse's name, your children's names and ages, hellos to other classmates, what you did last weekend, where you went on vacation, what you think, and what you're thinking about.

I'm spending my time in four places these days: Susan, job, work, and fraternity. Susan starts her third year of psychology school this fall, and after a year of disarray we finished the bathroom downstairs. The kitchen is next! Job is consulting for Leaf Systems in Southborough, Mass., writing image processing software on a Mac. The boss is a dream come true. Work is writing music performance software on the Macintosh and selling the idea to serious musicians. The fraternity, good old Fiji house, underwent a total renovation this summer with me calling the shots, and the project has been an absolute success.

Nancy Dean, the mother-in-law of classmate **Jack Diass**, wrote with news recently. News via mother-in-law is a perfectly acceptable method of information transmittal! Jack and Meg live in Rochester, N.Y., and their long-awaited second child was due to arrive from Korea shortly. Their first child, Lili, was 5 last April, "an absolute treasure, and we all expect Sam to be one, too."

Jack's at Kodak in biochemistry, and Meg is freelance writing. Nancy's proud of the kids, or couldn't you tell?

Martin Cohen has moved from management back into research as a research fellow at American Cyanamid. He says he's working on development of high-performance plastics additives. "The birth of my son David last October brings my family to a 'full house' (literally) with sisters Jessica, 8, Rebecca, 5, and my wife, Marie."

A year ago March, the Energy Laboratory at MIT sponsored a conference entitled "Energy and the Environment in the 21st Century." From that conference a book of the same name was published recently. **Howard Herzog** of the Energy Laboratory was instrumental in both projects as a conference organizer and a contributor to the book.

You don't have to write a book to write your secretary. Have an ice day.—**Lionel Goulet**, secretary, 115 Albemarle Rd., Waltham, MA 02154-8133, (617) 899-9694

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Happy Holidays, everyone! Here's news from our classmates. **Keith Milkove** writes, "I still live in Beacon, N.Y. I now work at the IBM Research Division in Yorktown Heights, N.Y. I am having lots of fun tinkering around in my lab. My son, Harlan, is 7 years old and is growing at a frightening pace. I recently saw **Les Feldman**, '76, who is a native Beaconite." . . . And this note from **Ronald W. Fox**: "After graduation, I drove a cab for Cambridge Yellow, then moved to Chicago. Eventually I got an MS in biochemistry from the Chicago Medical School and went to work at Baxter Healthcare Corp. in 1981. Carol and I promptly took advantage of their medical benefits and had Julie (9) and Danny (5). For the last eight years, I have been working in data processing; I am currently manager of technical planning and network services for Baxter's I.V. Systems Division (\$800 million in sales). I was the Chicago Computer Society's systems operator for two years and their vice-president for three; they went from 250 members to 2,500 during that time. PKTers should call when they are in Chicago."

I received a nice letter from **Janet Johnston**, who had this to say: "I have some pretty good news. After spending a year in the Office of the Secretary of Defense working on science and engineering education programs (on leave from the Air Force Geophysics Laboratory in Massachusetts), I am going on an overseas assignment for three years. I'll be the geoscientist liaison at the Air Force's European Office of Aerospace Research and Development in London. I'm really excited about the assignment because it entails setting up partnerships between the domestic basic research laboratories and their European counterparts. I will even get a chance to use the Russian I studied at MIT. If any of my old friends are going to be in the area I'd love to get together. After October 15, my address will be: EOARD, PSC 802, Box 14, FPO-AE 09499-0200, or from Europe, EOARD, 223/231 Old Marylebone Rd., London, NW1-5th, United Kingdom. Meanwhile, I am still studying voice, writing science fiction, and have gotten some real jobs as historical costume designer for theater."

And another nice letter from **David Katz**, who writes, "I just got the August/September issue of *Tech Review* and realize that the only way to see my name in print is to write. Amazing how that works! At the reunion, I asked people if anyone had been through a merger. The company I was with had just been acquired by a conglomerate. Well, the bad news was that the new management of my company closed the office I was managing in Princeton. The good news is that my former employer, Climatronics, wanted me back so much that they were glad to have me open an office in Pennsylvania working out of my house. I send the kids, Robert (9) and Daniel (7), off to school after Karen leaves for work and am

home when they pile off the bus. Child care is available when I have to travel. When all this happened last fall (1990), Karen went back to work full time. She is now working for the Trane Co. as the labor relations and training manager at their facility in Trenton. They have an hourly work force of 850 people and are implementing "just in time" techniques to help improve the efficiency of the plant. Life in Bucks County, Pa., is good. I just received my license as a soccer referee so I can participate without getting run over by Pelé-wannabeers. If we can only do something about the spectators."

And finally, I received a much welcome letter from **Stephen Chapman** recounting the events of 1990, a truly pivotal year in his life and career. On September 12, 1990, Stephen and his wife, Suzanne, had a son, John Wyatt (whom they call Wyatt and I would call cutie-pie or doll-face based on the adorable picture enclosed). Two days prior to Wyatt's birth, Stephen's father suffered a heart attack and a few days later underwent emergency bypass surgery. Fortunately, his dad made a full recovery, lives nearby, and enjoys visits with his grandson. That must have been quite a time, and, as Stephen put it, he got to reflect on the possibility of having a son and losing a father in the same week. Businesswise, 1990 could have been devastating. Writes Stephen, "The collapse of the New England real estate market was compounded for me because the now-failed Bank of New England was my lead lender for ten years. In the process of trying to save itself, it almost buried me. My destructive litigation with BNE was mediated to a close because there was a strong desire on their part to extinguish me as a problem by the end of the third quarter of 1990. The outcome of the year was the emergence of a new and different Stephen Chapman (possibly improved) with slightly more time on his hands and a newly refined focus on life's priorities. This new focus is reinforced by repeated pauses to reflect on the

fact that this September will mark my 20th anniversary of arriving in Boston with my MIT catalog under my arm, so I would be recognized and collected at the airport to be shuttled to the campus and R/O week. These days I find myself often recalling the relationships and experiences from those first five years in Boston."

Stephen added that he got to see **Steve Streifer**, his wife Diane, and son, Jacob, in the spring of 1990 when Streifer was recruiting at MIT. [I must correct some misinformation from my last column—Streifer's son was born in September 1989, not 1990 (sorry, Steve, there was no date on your Alumni/ae Fund note)]. At that time, Chapman, Streifer, and **Peter Blanshan** got together, and (on repeat occasions) they hope to get **Cliff Wald**, **Even Schwartz**, and **Chuck Reichmann** to join them. Chapman and Peter were planning a trip to San Diego this November so that "Jacob can give us some sailing lessons and Wyatt can see a real Panda (at the San Diego Zoo)." Sounds like fun. And, yes, I'd love to see you if you get to New York.

As for me, I continue my attempts to revive my 108-year-old row house in Brooklyn—had a crew of six sweating them completely replace my slate roof during the 90-100 degree heat spell in July. My patent law practice keeps me out of trouble (unfortunately), and I will soon have occasion to travel to Oxford to work on a litigation matter with Professor Jack Baldwin who, as many of you will surely recall, taught us our first dose of organic chemistry (5.41) 20 (!) years ago. Though I don't remember much chemistry, I seem to remember him taking a pie in the face. And didn't someone streak through one of his lectures? Those were the days. . . . Thanks so much to all of you who have written to me. I really appreciate it, and it makes preparing this column a lot more fun. Until next time—**Jennifer Gordon**, secretary, c/o Pennie & Edmonds, 1155 Ave. of the Americas, New York, NY 10036

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We have an abundance of news. . . . From a postcard from **Raphael Blumpkin**, while vacationing in London: "I've fallen in love with London. I have to figure out how to get an expat job and live here. I arrived five days ago, and I'm already too civilized to go back to New York City." . . . **Larry Appleman**: ". . . in May, I graduated from New England School of Law, number one in my class. Last month (July 1991), I took the Massachusetts Bar Exam. For now, I still work at Learningways, Inc., developing educational software."

From **Daniel Christman**: "I have now been at Rohm and Haas Co. nearly 11 years. It's hard to believe how the time flies!" . . . **Jordan Wouk** writes: "My wife, Kathy, has enrolled as a graduate student in special education for blind infants at Columbia Teachers' College." . . . **Beverly Jamison** says, "Just completed my second year as an assistant professor of computer science at the University of Hartford. My husband, **Rick Jamieson**, and I completed our first year as Education Council members." . . . **George Todd**: "Been working in the oil fields of Texas since 1976 and running my own production company since 1987. I run into a few alumni in the business, including **Todd Bulkema**, '78, **Jarn Marcou**, '78, and **Paul Haynes**, '77. However, I meet more alumni sailing in Texas and the Bahamas, including **Paul Erb** and **Barbara Belt**, '77, who are both excellent windsurfing 'board heads.' I gave up dating sheep last year and married a beautiful blond from Dallas named Jan Wisdom. Those sheep were a lot of fun, but they couldn't cook worth a damn. I'm eating much better now, thank you."

Allan Levin recently became a principal of the Decision Support Technology Division of Softbridge, where he provides consulting and systems development services to Global 2000 firms. "Spent most of 1990 traveling to Europe and Aus-

If it weren't for ProNet, I wouldn't have this job. I applied for a position and didn't hear anything. At the same time my resume came up on a ProNet search for that job. The search resulted in an interview for me... and the job I really wanted. ProNet made the difference.
Mark Peters '87
West Palm Beach, FL

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tralia to help expand our worldwide business activities. I treasure my time with my wife, Marla, and two kids, Todd (6) and April (9). . . . **Daniel Franklin** writes: "After working at Bolt, Beranek & Newman (Cambridge) on life science research software for five years, I recently changed projects. I now work on the BBN/Slate multimedia document preparation and mailing software. Real commercial software is quite a change from NIH-sponsored work. . . . **Richard Ottolini** joined Unocal Corp. in L.A. as a research geophysicist after six years on the research staff at Stanford University. . . . **David Stork** has been since April 1990 senior research scientist at the Ricoh California Research Center, and has recently been made consulting associate professor of electrical engineering at Stanford University, where he teaches "Adaptive Pattern Recognition and Neural Networks." His wife, Nancy, is assistant professor of English at Stanford, and their son, Alex (3), is already Macintosh literate. "I've been active in local music, performing a tympani concerto and a marimba concerto this year."

Janis Bestul Ossman's family is growing—Andrew David was born a month early on April 30, 1991, at a healthy 7 lb., 8 oz. He joins sister, Rachel Elizabeth, who is 4. "I am still at Stone & Webster in Boston, working as a project manager. My husband, Bill, '79, is now at the Medical Imaging Division of Hewlett-Packard in Andover, Mass." . . . **Roger Allison** has been a single parent since his wife, Deborah Halter, was called to active duty. She will return when everyone else has left. Roger is still working for the city of St. Louis on its convention center expansion project. . . . **Neil Kaden**: "Still happily married to Criselda Palomo Kaden, sharing a suburban DF/W home with two cats, two English springer spaniels, and several generations of starlings nested in the eaves. Still managing UNIX (and other associated) computing for a division of BNR—got a \$2 million turbo charger for the mainframe and a few hundred more UNIX workstations, but otherwise not much has changed in the last year." . . . **Andrew Farber**, MD, is practicing as an ophthalmologist in Robinson, Ill., where Heath Chocolates are made. He and his wife Jeannie, have three sons—Mike, Danny, and Adam.

We have finally, after 15 years, heard from **Richard Koffler**: "I am now the president of Radiology Management Systems, Inc., developers of RADMAN, a family of computer products for radiology. In less than two years we have already positioned our company as an industry leader in innovation, quality, and customer satisfaction."

. . . **Ben Szaro**: "Recently left the National Institutes of Health for an assistant professorship in the Biological Sciences Department of the State University of New York at Albany. I'm looking forward to the challenge of running my own laboratory—I'm not looking forward to competing for my own share of the ever dwindling supply of grant money." . . . **Jeslie Chermak**: "Managed a 13-week vacation! Got to see most of Europe (after seeing half six years ago). Short jaunt into East Germany (before the unification) was very interesting. Eastern/Central Europe merits a trip all its own, but do I go there next or to some other part of the world?"

Raphael Shine, MD writes: "Arlene and I were married January 24, 1988. Last June we had a daughter, Lindsay, an energetic, curious child who keeps us quite busy. Career-wise, I've been in my own practice as an internist for just over five years. The practice is growing slowly but steadily." . . . **Kenneth Davis**, MD writes: "Our second son, Earl Harrison, was born May 2, 1990, joining his brother, Jack Michael. My practice, Elizabeth Pediatric Group, is also expanding. We added a new associate in July, and we plan on opening a second office in Summit, N.J." . . . **David Lee**, MD: "Still working as a radiologist in Brighton, profiting from the medical/legal/technologic imperative: if the technology is available, it must be used. And from the desire for objective machinery to make difficult decisions free of blame. Also taking guitar lessons." . . . **Richard**

Davey, MD, has finally written: "Graduated from Columbia Physicians and Surgeons in 1980. Internship/residency at Boston University in 1983. Infectious diseases fellowship at NIH, Bethesda, Md. Currently, medical officer, National Institute of Allergy and Infectious Diseases, NIH, Bethesda, doing clinical work in HIV infection. Married, 7-year-old daughter."

Thomas Downey: "Now vice-president of product marketing at BBN Advanced Computers, Inc., a manufacturer of massively parallel supercomputers. I am also moving, having sold my house in Brighton, and we are looking in Newton and Winchester." . . . **Russell Chipman**: "Living in Huntsville, Ala., raising rabbits, and teaching physics. Spent two months traveling through Japan, studying Japanese, and enjoying the local hot spring baths. Can't wait to go back. No children yet, just bunnies." . . . **Michael Baumann**: "Moved to a new house in Kensington, Md., as of March 1, 1991. Still working as an economic consultant at Economists, Inc., in Washington, D.C. The recent downturn in the economy has slowed merger related work. Fortunately, there are still civil and criminal suits." . . . **A. Carl Sharon**: "Continuing my work as Lutheran campus pastor at Yale. An especially exciting part of my work is the Yale Faith and Science Colloquium, a weekly gathering of students and faculty to discuss issues of science and faith. We've been doing a series on ethics, covering such topics as ethics of AIDS, ethics in science (especially where unintended consequences develop from research results), and evolutionary biology and the origin of ethics. We're the only intellectually credible faith expression on Yale's 'Science Hill.'" . . . **Bob Holzwasser** announces: "Our second daughter was born on November 20, 1990. All is well. Our military won one! Three cheers for our men, leaders and weapons. Tough luck, Noam Chomsky, you can't always be wrong, or can you? Here's a donation in spite of his continued employment."

Thomas Hirasuna has been elected secretary/treasurer of the Food, Pharmaceutical, and Bioengineering Division of the American Institute of Chemical Engineers for 1991. . . . **Scott Munroe** has joined Analog Devices, Inc., where he will lead a team developing mixed-signal systems on a chip. For the last 13 years, Scott was a staff member at MIT Lincoln Laboratory. . . . **James E. Short**, a research associate at the Sloan School, has received this year's Richard Beckhard Award, given annually by the Sloan School and *Sloan Management Review* for 'an outstanding paper on the subject of planned change and organizational development.'" The article is entitled: *The New Industrial Engineering: Information Technology and Business Process Redesign*, and appeared in the Summer 1990 issue of the *Review*. It discusses ways in which information technology can be used to redesign business processes. . . . **Robert Sand** writes: "Still financially afloat as a scientist with North Star Research Corp., a small business in the state of Neuva Mexico, where Richard Adler and I write so many proposals that when a contract does come in we rifle the filing cabinets trying to find a copy of the proposal to remind ourselves of what we said we would do! North Star has been very stable over this last year of uncertain economic times in the defense related industry, and we are finally making some entry into the commercial market with our new product catalog of high voltage equipment. I have had a great deal of fun with the successful completion of several research projects. Occasional trips to California and one to Denton, Tex., break the relative serenity of hectic production activities at work. I still teach astronomy at UNM in my few microseconds of spare time, although I have reduced the total number of classes, and play tennis with what is left."

Bill Brezza has been appointed director of strategic sales by Ericsson GE Mobile Data, Inc. He is responsible for sales, support and program management in key Mobitex target markets. Bill is a pioneer in the field of spread spectrum wireless LAN technology. . . . **Neil Lieblich** sends a la-

conic note: "I'm chairman of Pediatrics at Benedictine Hospital, Kingston, N.Y.; have two children, Ross Henry, 6, and Erica Faith, 2; and [am] in charge of Neonatal Resuscitation Course for our region." . . . **Gwendalyn Champion Baumann** writes: "Paul and I now have three children—Karl, 5, Eric, 2, and Natalie, 9 months. I have been working at a contract lab doing metabolism chemistry. Paul was transferred to Savannah in January."

Roseanna Means, MD, finally sends a note: "I've been getting *Technology Review* for 15 years and have yet to recognize more than a few names from my class. I guess the people I've stayed in touch with are just as busy as I am—and no time to write. Since graduating, I got an MD, completed an internal medicine residency at Brigham and Women's Hospital in Boston, tried to work at an HMO and hated it. Then I went into private practice and didn't much like that either! Now I work at Mass. General Hospital seeing only outpatients, most of whom are very poor. I'll be starting a clinic for the homeless in July. I have three children, all boys, ages 7, 4, and 1. I'm married to Peter Beaman, '77. I also manage the Friends of MIT Crew, and I'm always on the lookout for former crew members. We are the largest 'Friends' organization at the Institute. We support the MIT Crew Team in a variety of ways and have held events so current and former crew members can meet and relive each other's 'glory days.'"

Your secretary had a delightful phone conversation with **Ed Kashdan**. Ed has changed companies and is now working at Ecology and Environment, Inc., in Philadelphia. He was formerly with Galson Technologies. Ecology and Environment is an environmental interdisciplinary consulting firm with 24 offices worldwide. He has been working in hazardous waste investigations including pipeline activities, including PCB contamination problems. In addition to investigating, he also recommends solutions.

There is a painful element in being the class secretary. It is writing obituaries. We have three. . . . **Lawrence Goldstein**, a software developer, died of cancer January 26, 1991, at the New England Deaconess Hospital. He was a senior member of the technical staff at Seque Software, Inc. He lived in Belmont. Lawrence was a native of St. Louis, and leaves behind his wife, Oakley; his mother, Ida Seldman of St. Louis; and a brother, Jerome, also of St. Louis. . . . **Augusto Octavio Rodriguez** died on May 28, 1986. We just learned of this in July. He was the president of his own firm, Landmark, SA, in San Jose, Costa Rica. We do not have any additional details other than he was survived by at least his mother, Anne T.D. Rodriguez. . . . **Anthony "Tony" Lake** died on July 4, 1991. Tony is survived by his wife, Carol. Tony was the regional director of computer and communication consulting for Peat Marwick in St. Louis. Tony, along with two other business associates, was gunned down in Atlanta, a victim of random violence. Last year your secretary tried doing some speech recognition business with Tony and had quite a few enjoyable conversations.

As for your secretary, thank you for re-electing me to another term. However, I still need your help in providing me with news for the Notes. Insofar as business is concerned, it is terribly frustrating. Speech recognition is being swamped by mice, Microsoft Windows 3.0, and the upcoming pen-based operating systems. I believe after my extensive struggle to move into the PC mainstream, that the speech recognition industry is somewhere between five and ten years ahead of its time. The medium is too radical when compared with the eye/hand keyboard-based input culture. The other widely accepted input media are all hand-based—mice, digitizers, touch screens, and pen point. Battling this deeply embedded culture has been extremely frustrating.

So in order to make a living, I have turned back to finance and have put together a small, but growing, consulting firm for derivative products, which I have named Quantalytics, Inc.

I am also exploring doing a deal with a data communications vendor to do the marketing and some of the sales. The business is an interesting one. I remain an entrepreneur, partly by choice, partly by necessity. Being an entrepreneur appears glamorous, but it involves a huge amount of work. There is an important caveat of mine I wish to share: the boss always gets paid last; hopefully the best, but always the last. Do bear this in mind if you get the urge to start your own business.—**Arthur J. Carp**, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, Fax: (516) 295-3230

77 15th Reunion

Dear classmates, it fills me with great sorrow to report to you the deaths of two of our classmates. **Richard E. Maebius** of Pittsburgh died in April of this year. He is survived by his mother, Anna. No further details were available. . . . We have also just received word of the equally untimely death of **Ian C. Smith** in June 1990 in Munich, Germany. Ian lived in Trinidad and is survived by his parents, two brothers, and a sister. To both of these families we extend our heartfelt sympathy.

On a more upbeat note, **Mark A. Mintun** wrote a note from his home in Pittsburgh. He reports that he and his wife, Susan, had a 10 lb. 14 oz. baby boy, Jacob, in May. In April, Mark began his job as director of the new Positron Emission Tomography Center at the University of Pittsburgh Medical Center. He would like to say "Hi" to all his old friends at New House 5. . . . It's not too early to be thinking about attending our 15th (can you believe it?) year reunion next spring at the Institute. We are definitely planning to see many of you there. Let's top our 10th year reunion attendance of fewer than 150 classmates! Watch this space for more details. . . . Finally, I would like to add that our family is doing well. Joia will be attending public school this year after four years of Montessori experience. Her brother, Kellen, will start his Montessori elementary program (equivalent to first grade) this fall at a different school in Alexandria, Va. The "baby", Brielle, will attend a two-day a week co-operative preschool. That's it for this month. I wish a joyous and peaceful holiday season to you all.

Do write soon. I strongly recommend using the e-mail route to report your latest exploits. It's fast, it's easy, and it gives my husband, Paul, something special to take home to me from work. Of course, the more conventional routes are also acceptable. Mail should be addressed to: **Ninamarie Maragioglio**, secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153-2522, or send e-mail to hertz@ccf3.nrl.navy.mil (internet)

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Our congratulations go to **Diane Waters Hargrove** who joined the Mississippi Department of Health as a district administrator this past May. At the Tute, Diane earned an SB in urban studies and economics. She later earned a master's in regional planning from the University of North Carolina, Chapel Hill. Before her current position, Diane worked in higher education, first as assistant director of financial aid at Princeton and then as



Diane Waters Hargrove

director of development and director of institutional research and planning at Mary Holmes College in West Point, Miss.

Barb Ostrov writes, "My husband Joel Buckley, '76, ten-month-old daughter, Meredith, and I are moving to Hershey, Pa., in July (1991). I am starting a pediatric rheumatology center at the Milton S. Hershey Medical Center and will also be practicing adult rheumatology." . . . **Neil Cronin** writes that he is now working Q&A for the Federal Aviation Administration on high-level design of the National Airspace System. He writes that he is constructing a satellite dish/radio telescope, but his note doesn't indicate if this is part of his work, or his hobby! Neil is living in Billerica, Mass.

Mike Geselowitz, wife Emily Schneider, and first daughter (Reyzi Reba) were joined by a second daughter (Gabriela Fanya), born in March. In a note along with the announcement, Mike writes, "I'm still on the research staff at the Institute (in the Center for Materials Research in Archaeology and Ethnology), so I got to march in Charles Vest's inauguration. I met quite a few Bakerites there, but I think the only Class of '78er was **Yvonne Tsai**, who was with husband Scott Kushtell, '79." Mike says that he has run into a surprising number of Bakerites working around the Tute as well.

That's about all the news that's fit to print right now. Best wishes to all for safe and peaceful holidays.—**Jim Bidigare**, secretary, 322 Central Ave., Newark, OH 43055

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Paul Hoffman just published a book, *Getting the Most for Your Home in a Down Market*, co-authored with Dan Lieberman, '81. He is also keeping busy with free-lance manual writing. He has been living in Berkeley, Calif., for ten years. . . . **James Liebmann** is a research scientist living in Kensington, Md. . . . I spotted a product review in a recent issue of *MacWeek* that was written by **Becky Waring**.

I'm afraid that's all the news this month, so I'll have to talk about myself. I have been very busy with my new job. I'm managing seven people and am practicing the fine art of delegating! I have also been doing some traveling, giving me ample opportunity to practice my newly obtained driving skills. (Yes, readers, after 13 years of having a driver's license, I am finally putting it to use.) Last weekend, on the New England Thruway on the way to Cape Cod, I attained a major driving milestone—my first speeding ticket! While on the Cape, I had the pleasure of spending time with my good friends, Arnie and Lori (Ullman) Herman, '81.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

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My first letter comes directly from **Long Tran**. He proudly announces that he has been elected to Who's Who Among Young American Professionals, Marquis' Who's Who in the South and Southwest, and Marquis' Who's Who in Finance and Industry. He also just passed the ASQC Certified Quality Engineer and the SME Certified Manufacturing Engineer exams. Long will start the MBA program at the University of Louisville this fall.

Two birth announcements this month: **Hillary Canning** and her husband Michael, '84, are the proud parents of Caroline Ruth born May 23, 1991. Twins (a boy and a girl) were born to **Susan Weil Bates** in February. In January, Susan, her husband, and their two-year-old moved back to Michigan where her husband is busy with his new church and Susan cares for their children.

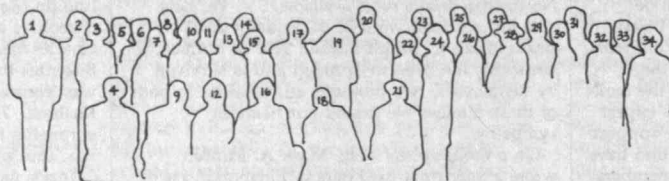
Be on the look out for **Kathy Sheffield**. After spending a year with a private group practicing internal medicine she is about to start a year of traveling taking temporary assignments through-



MIT guests at the August 11 wedding of Hyun-A Park, '83; and Jacob Friis, SM '90:

(1.) **Nam P. Suh, '59**
(2.) **Michael Goldberger, '83** (3.) **Susan Uhm, '93**
(4.) **Chris Oh, '93**

(5.) **Patti Golderger, SM '85** (6.) **Helen Suh, '85** (7.) **Mari Sugahara, G**
(8.) **Andreas Mortensen, PhD '86**
(9.) **Kevin Chang, PhD '88** (10.) **Sarah Tabler, '84** (11.) **Cherie Wendelken, G**
(12.) **Chris Lindblad, SM '89** (13.) **Diane Junker, SM '90** (14.) **Erin Hester, '82**



(15.) **Gabriela Sopelsa, SM '90**
(16.) **Matthew Prete, '82** (17.) **Paul E. Gray, '54** (18.) **Hidehori Aritake, SM '90** (19.) **Hyun-A** (20.) **Jacob** (21.) **Peter Zaballos, SM '90** (22.) **Pricilla Gray, H** (23.) **Victor Olgay, MArch '86**
(24.) **Dawna Levenson, '83** (25.) **Adrian**

Yovanovich, '83
(26.) **Cynthia Pacheco, '83** (27.) **A. Billy Lundberg, '85**
(28.) **Deborah Poodry, MAA, MCP '79**
(29.) **Steve Kadish, MCP '82** (30.) **Linda Snyder**

(31.) **Andrew Weaver, MArch '86**
(32.) **Paul Nahass, '83** (33.) **Gene Park, MArch '87** (34.) **Architecture Professor Kyu Sung Woo. Not shown, but also attending were: Karen Levine, MCP '90; Miriam Maxian, '86; and Phillip Yoo, SM '87.**

out the country. She hopes to bump into some classmates.

Like Long Tran, you can send your news directly to: **Kim Zaugg**, secretary, 2384 Leslie Circle, Ann Arbor, MI 48105, (313) 665-2365, vayda@erim.org.

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From the Potomac to the Pacific, and beyond, here's this month's doings:

Volume Two . . . Michelle Lucier-Glatz informs us that her second daughter, Brittany, was born August 14, 1990. Her big sister Shannon (now 2) is helping mom out. Michelle is enjoying being back at work at IBM as of April 1991. Meanwhile, husband Bob, '80, graduated in May 1991 from the University of North Carolina law school.

Scoping it out . . . Charles Proffitt reports that he currently has a post-doctoral position at the Space Telescope Science Institute.

Waiting for the upturn . . . Cliff Heyer continues as president of CodeCraft Corp., a systems integration and facilities management firm, in Wellesley. Cliff says he "took a big hit" this spring when the recent downturn in the economy impacted several of his key accounts but, happily, is on the road back to recovery.

Xinjiang or bust! . . . John Salmon and wife Lynn Garry Salmon, '82, seem to have taken a wrong turn on the way to the reunion. Instead of heading right at San Francisco, they went left and ended up somewhere on the Silk Road in Central Asia. As of the end of May, the intrepid duo had been traveling across China for about two months and were due to cross the Kunjerab Pass into Pakistan. Lynn's fluent Mandarin has proven handy along the way. Additional motivation for the expedition no doubt was provided by John's having finished a PhD in physics at CalTech in December 1990.

And how was your summer?—**Mike Gerardi**, secretary, 1250 S. Washington St., #807, Alexandria, VA 22314, (703) 548-8409

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Please send news for this column to: **Stephanie Pollack**, secretary, 135 Sutherland Rd., Brighton, MA 02146

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Not very much news this month. But what we lack in quantity we hope to make up for with quality. Here's the scoop: **Steve DeFalco** is enjoying his career with McKinsey & Co. and has just accepted an international assignment in Copenhagen. Steve, wife Rosemary, and sons Tommy and Steven will all make the move for the next year or so. You can get in touch with him via the McKinsey Copenhagen office.

The following people took time to jot down what they are doing and sent it in along with their donation to MIT: **Mark DeWitt** just completed the first year of an MA/PhD program in ethnomusicology at Berkeley. This summer Mark is working on a multi-media database project at Xerox PARC, and says he sees some vaguely familiar MIT faces. Mark is also working on advancing the state-of-the-art of computer-aided music transcription. Next year he will be the teaching assistant for the University Chorus and he will take his master's exams.

Randall Pratt writes that he recently left his position in CMOS IC design at Bell Labs to become a missionary in inner-city Newark with World Impact, Inc. Randall works with teens in the city and teaches science to kids at World Impact's school in Newark, N.J. . . . **Robert Cox** left his job at Applied Materials to begin an MBA program at the University of Southern California. He will be studying international business in a special program where students have an average of 10 years of work experience.

Robert Norwood writes that he is currently living in New Providence, N.J., which is nice but a lot more expensive than Philadelphia (where he

had been since MIT). Robert works as a research physicist at Hoechst Celanese (pronounced Herkst Sell-a-knees), and is researching non-linear optics. He and his wife Mary are looking for a house in New Jersey. . . . **James Martinez** married Anne Jolly on May 19, 1990. . . . **Diana Tener** writes that she went to the Folklife Festival in Seattle with Sudhansu Jain and Jon Urheim, '84. They then went on a tour of Whidbey Island and "had a blast!" but no further details are available.

How about writing in and telling the rest of us what your friends are up to? Don't let the truth get in the way of a good story. We'll have plenty more columns to correct false accusations.—**Jonathan Goldstein**, secretary, TA Associates, 45 Milk St., Boston, MA 02109

84

Christopher Linn, '87, finally got smart and asked **Patricia Kellison** to marry him. The result? A gorgeously non-traditional outdoor wedding ceremony in May. The happy couple is now contentedly settled in a cottage in Woodside, Calif. . . . **Teresa "Chickie" Colucci** will be student teaching high school math in the fall and hopes to be certified to teach in December. Mike, '82, and Chickie will be in Boston next summer for Mike's 10th reunion. Son Joe (19 months) will be along too, hoping to see Mom and Pop's crazy college compatriots.

Robin Johnson recently accepted the position of curator at the Atlanta Museum of Science and Technology. She also intends to continue writing *SciTech* articles on a free-lance basis. . . . **Diana Tener, '86**, was seen at the Folklife Festival in Seattle with Sudhansu Jain, '83, and **Jon Urheim**. After the festival, they went on a tour of Whidbey Island. . . . **John Davies** graduated from Jefferson Medical College with an MD. John will be in residency in family practice at Duke University Medical Center.

Finally, a nice long e-mail update from **Tim**

Chambers. "Robin and I had a son May 17! We're proud to announce Blake Whittaker Chambers, 8 lbs. Robin is getting precious little sleep on maternity leave. I am hardly faring better. She says: 'Hi, y'all! She had an exciting third trimester because we moved to a brand new house at the end of March. We weren't planning to move, but we received an unsolicited offer on our house and jumped at the opportunity to move to a beautiful little town ten miles north of Colorado Springs called Monument. Our moving day started out with gorgeous sunshine, but nature decided to have the annual Colorado March blizzard that afternoon! We had to lock up the truck and finish moving the next day. We now own a family-sized house on about three-quarters of an acre of Colorado prairie. (And, I'll mention just in case any friends happen to be in our neighborhood, a guest room that has a fantastic view of the Rockies!) We spent a week at the Lawai Beach Resort on Kauai, Hawaii, in December. This was our second time on Kauai, our first being on our honeymoon. We recently heard that **Carmen (Fernandez) Metzler** brought William Joseph Fernandez Metzler into the world on May 8. Robin's career is going well. She's a product marketing engineer for HP Logic Systems Division. She negotiates strategic contracts with third parties. My job as of late has involved user interface software development for our cross-debugger using the OSF/Motif standards and libraries."—**Howard Reubenstein**, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213 (home) hbr@mitre.org

85

The envelope of news reported lost last month has been recovered from one of the zillion cavernous pockets of Bill "Brain Death" Messner's new Eagle Creek book bag. Once again many apologies for this fiasco.

Tons of news this month brought to you via e-mail, the alumni office, and gleaned from the latest class secretary fact-finding junket to the Boston area. First the hi-tech stuff. **Rodney Schmidt** reports the low-down on his wedding. On June 29 he married Allison Riebe in Minneapolis. Attending MIT alumni included **Andy Westcoat** and his wife Hee Jung (Ko), '87; **Mark Emineth**, '86; **Jim Manzi**, '84; **Anthony Scotti**, '86; **Arnie Burke** and his wife, Sue; **Oren Michels** and his wife, Jacquie; and **Gary Wyetznar**, and his fiancée, Germain Guetierrez. After spending a week in Hawaii, Rodney and Alison are living in wedded bliss in El Toro, Calif., while Rodney works for Advanced Logic Research designing PCs. The rest of the news on the Baker House Alumni Club of Southern California is: **Andy Westcoat** is at Mobil in Torrance, **Arnie** is employed by Douglas Aircraft in Long Beach, **Gary** is at Aerospace Corp. in El Segundo, and **Oren** works for PACE International Corp in Culver City.

The latest installment of the continuing saga of **Danny "DanO" Orange** arrived at my terminal recently. Dan has a post-doc at Santa Cruz for 15 months. He says he almost feels like a valued employee with all of the benefits and money. Essentially he is continuing work on projects with which he was already involved, namely: 1) investigating the interaction of fault zones and fluid flow deep in the earth's crust; and 2) trying to figure out if fluid squeezed out of the earth is strong enough to create submarine canyons. (The answer to 2 is yes.)

Rob Gandara e-mailed that he graduated with an MS in electrical engineering from Georgia Tech and that he was instrumental in turning the football team around and into national champions. He also received a certificate in computer-integrated manufacturing systems. He now works at DEC's chip manufacturing plant in Hudson, Mass.

Matt Giamporcuro moved to California (the "lesser coast") in October 1990 to design equipment for a "robotic rock concert lighting company." He shares a house with **Dave Lyon** and

Stephanie Taddy, '88, who just returned from two years in Japan. Matt is also tutoring high school students as part of the Science Literacy Program of the MIT Club of Northern California. . . . **Ann Dalton** is working at the Jet Propulsion Laboratory doing science instrument accommodation and integration on spacecraft. She says that the work is fun and interesting and that spacecraft science experiments remind her of Junior Lab.

Cynthia Paschal is still working on a PhD at Case Western Reserve University and hopes to finish in 1992. **Roberto Engels** is married to Marina and living in Brazil. He is working as a product manager for Santista Textile Mills. **Sara Wright** has been working for five years at a hospital in San Francisco in a neuroscience research lab studying amyotrophic lateral sclerosis, (Lou Gehrig's Disease). **Alan Williams** was assigned to Onazuka Air Force station in Sunnyvale, Calif., starting in September 1991. . . . **Chun Nip Lee** announces that his wife Suk Ning gave birth to Isaac Sebastian Lee on March 1, 1991. Chun Nip will be taking a tenure track position in mathematics at Northwestern University. **Noell Merritt** is engaged to Art Merkin, Harvard '85 and '90, in October 1991. She still works for IBM, but now lives in L.A.

Christopher Zannetos recently started a network integration consulting and development company with three partners. His company now employs ten people, and business prospects continue to look good. **Hans Lee** is program manager for IPL Systems, maker of storage products for the IBM AS/400. **Kaikobad Irani** will be starting as a clinical associate at the National Heart, Lung, and Blood Institute in Bethesda, Md. **Christian Getschow** is a software development engineer for Aerodyne Research Inc. of Billerica, Mass. . . . **Lt. Justin Ryan** is an A-6 pilot in the US Navy. He just returned from Desert Storm where he was stationed on the USS *Saratoga* for eight months. His squadron dropped 1.7 million pounds of ordnance on targets in Kuwait and Iraq.

Attending a summer barbeque party at the home of **Gail Gordon** were **Josh Marantz**, **Bill Oppenheimer**, **Ernie Fasse**, **Shelly Johnson**, **Jill Tobin**, and **Todd Tsakiris**, '86. Gail will be finishing a PhD in September 1991. Last summer she was in Japan, and this summer she will be climbing in Joshua Tree and diving at La Paz. Josh and Gail recently won a trophy at a ballroom dance competition. Ernie is still a grad student at MIT in mechanical engineering. (Perhaps that is where he learned to make his killer cherry torte.) Shelly says that she went white water rafting on the Yuba River in California and nearly died. Finally, **Jill** and **Todd** were married on July 14, 1991, in a ceremony where Gail "write-this-and-you-die" Gordon had hoped to catch the bouquet.

Please help ease the burden on the post office's mail forwarding system by sending news directly to my latest new address: **Bill Messner**, secretary, 2234 Jefferson Ave., Berkeley, CA, 94703, (415) 845-8119, internet: messner@cmls6.berkeley.edu

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Greetings from Hermosa Beach! I received several letters this month, so a hearty thank you to those who have contributed. **Donna Giesman** has finally received a PhD in genetics from the University of Pennsylvania. However, the last two years of her work were done at NC State, where her research adviser had moved. Donna recently married **Eugene Cookmeyer** whom she met at church, where they were both instrumentalists in the choir. They honeymooned at Martha's Vineyard and Boston. While in Boston, she ran into **Steve Strassman**, '84. He had just finished a PhD at MIT in AI and was contemplating which super job offer to take. Also, **Terry Simpkins**, '88, is studying music at Princeton, and **Mike Candan**, '85, is busy taking classes at Columbia while working full time. Donna will be conducting her postdoctoral research at NC State in the Plant

Pathology Department studying how plant viruses cause disease.

Mark Lucente reports from Cambridge, Mass., that **Carlos Moreno** recently married **Genevieve Fairbrother** (Wellesley '88). . . . **Andrew deRozairo** stopped by while on this trip around the world from Germany (where he lives and works) to Japan (where he will soon be living and working) to the U.S. (where he managed to remain nearly intact) and back to Germany. The bachelor party included broadsiding a hapless Korean compact, and a pre-dawn journey to Cape Cod to Tim Foley's ('85) beach house where prenuptial celebrations commenced for **Stephen "Quasar" Quattrociocchi**, who is scheduled to be married on the day of the eclipse. Stephen lives and works in D.C. for the Princeton Press. . . . **Andy Solem** was nearly talked into flying out for the festivities, but he declined since he was already preparing for a trip to Japan (where he'll be living and working at the Mitsubishi Heavy Industries plant as the FSX technical liaison officer for the Air Force). Carlos' wedding occurred at Harrisburg, Pa., where Mark performed his best man duties. Those in attendance included **John Ashley**, '85, and **Chris Hall**, '84. These two along with a cast of thousands bussed down to Baja for the eclipse. Mark finished by saying that he's enjoying graduate school so much that he'll continue to do research in electronic holography until he gets that spiffy white suit-jacket with the extra long sleeves. (Mark is working in the Spatial Imaging Group at the MIT Media Lab.)

Kim and **John Bartholomew** announced the birth of their son **Dylan Andrew** on July 24. Dylan was a whopping 12 lbs! Both mother and son are doing fine. **John** and **Kim** attended **Mike Straub's** wedding to **Lisa Hoffman** in New Jersey in June. Other Betas in attendance were **Michael Ruf**, '87, **Tony DiPesa**, **Jim Brennan**, '87, **Matthew Denesute**, '87, and **Martin St. George**. A great time was had by all.

Ann Sidley received a doctor of veterinary medicine degree from Tufts University in May. . . . **Diana Tener** attended the Folklife Festival in Seattle with **Sudhansu Jain**, '83, and **Jon Urheim**, which ended with a tour of Whidbey Island. . . . **Chris Gladwin** recently started a new job outside of Chicago doing product strategy and planning for Zenith Data Systems. . . . **Steve Kroft** was there to show him around the city. . . . **John Rulnick** just finished his master's in electrical engineering/operations research at UCLA. He'll be continuing on for a PhD. John will be marrying **Sarah Miller** in August in Massachusetts. This summer he did research in game theory and military strategy at Rand Corp. in Santa Monica.

Andrew Su attended Case Western Reserve University School of Medicine. He's doing his residency in internal medicine at Riverside Methodist Hospital in Columbus, Ohio. . . . **Lee Fortunato** is in a fifth year of grad school in molecular biology at UC/San Diego. Last year, she and her boyfriend bought a house. Lee hopes to finish up in the next two years when she'll get more time to surf. . . . **Stan Shull** completed an MBA at Harvard and moved to Seattle to take a position as "strategic analyst, corporate engineering and technology" for Boeing. . . . **Alan Foonberg** recently reached his eighth anniversary at the Aerospace Corp. in El Segundo, Calif., where he's been working as a project engineer. Alan and his wife, **Lisa**, sold their first house and bought a new one in Manhattan Beach. The southern California faction of **Theta Deltas**, including **Mark Brown**, **Dan Lane**, and **Logan Kapitan**, still convene regularly for pizza, poker, and beer.

Congratulations are due for **Karen Wohl** and **Ray Schmitt**. They finally announced their engagement! They plan to tie the knot sometime next spring. . . . **Karl Tucker** had another big blowout party before he left for Harvard and business school (and once again, I didn't make it for the party). . . . **Rich Maurer** was out visiting with some really cool video footage of Desert Storm. We almost hooked up with **Tom Paterson**

who was down on business in Thousand Oaks, Calif.

Thanks for the news.—**Mary C. Engebret**, secretary, 1805 Manhattan Ave., Hermosa Beach, CA 90254, (213) 376-8094

87 5th Reunion

What?! You want information on your classmates? You've been staying up nights wondering what has been going on? Please read on (and then send in your own information).

John Clarke writes with an update: "I'm in the middle of an eight-month leave of absence from IBM in New York City. I've been spending my leave backpacking throughout the western U.S., and I just finished cycling across America and down the western coast. Life is too short to spend it working like a dog. But it took my 27-year-old brother being diagnosed with cancer to make me realize that we might not always be able to do these kinds of things. So, work can wait. For the rest of my leave, I'll be traveling to Alaska, Canada, Europe, Nepal, and Africa. . . .

Mark Roman will be heading out to Phoenix to party with a cadre of alums on July 4th: A. Mike Chin, '82, Geoff Campbell, '82, Ruben Martinez, '83, VJ Holm, '84, Doug Hester, '84, Emmanuel Washington, '82, Rick Araiza, '83, Andy Wold, '85, **Martin Hunter**, and many more. He says, "Off to assault the Salt River. Doom is imminent. River rafting rules!" . . . **Polly Fisher** spent this past year teaching science and math at a tiny private school in Malibu, Calif. She's been spending her free time birdwatching and beach combing. In the fall, she will be starting a public school teaching credential program.

Jerry Hershkowitz writes: "Now that the missiles have stopped falling, I can finally enjoy the Tel Aviv night life. I moved to Tel Aviv in January, after spending six months in southern Israel learning Hebrew and am now working for Motorola. The war was quite an experience. Many of my thoughts went out to fellow classmates who were in ROTC and were directly involved in fighting. Their efforts, although great, were not quite enough to prevent a Scud missile from landing about 50-100 meters from my apartment. It was quite a night—luckily nobody in my building was hurt, only lots of shattered glass and other similar damage. Otherwise, I've gotten many compliments about my Brass Rat here in Israel, one guy even insisting that it must be handcrafted. I've become friends with Steven Blacker, SM '88, who I met while learning Hebrew. It's nice to have someone to talk with about Boston. For those who want, I can be reached at jerryh@msil.sps.mot.com."

Neal Hoyer sends a letter: "I've moved from St. Louis to Cincinnati to take a product development engineering job with Ethicon, a Johnson & Johnson company. Graduate School was no longer amusing nor economically reasonable, so I started my job search in the midst of the Gulf Crisis/War. Fortunately, I landed this great job where I work on surgical equipment—staplers and endoscopic surgery devices. The work has been interesting with loads to learn, plus great people with whom to work! Just before moving, I had some '87s visit me on an unusually warm February weekend in St. Louis. **Cheryl L'Arivee**, **Rovena Sobarzo**, and **Hoi-Man Siu** (now a fellow Cincinnati as he works for P&G) joined me and some Washington University friends for an excellent east Missouri event! Later in February, **Adam Kane** joined me for skiing in British Columbia. A great trip to the Great White North. Looking forward to seeing fellow '87ers next June, especially those who don't write! Shame!

Congratulations to **John Shackford Pitcher**! John received a master's in business administration from The Darden School at the University of Virginia. . . . And congratulations to **Stacy Dee Katchman** upon her graduation from Jefferson Medical College of Thomas Jefferson University in Philadelphia. She will begin a residency training

program in pediatrics at Thomas Jefferson University Hospital.

Please call or write me at my new address and give me the latest scoop!—**Stephanie Levin**, secretary, 159 West 80th St., Apt. 1D, New York, NY 10024, (212) 595-3172

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Happy Holidays everyone! Well, I guess this month's column wins the prize for conciseness. I'll start by advertising for our 5th Reunion. Although it is still a couple of years off, we need to start getting a committee and chairperson together. If anyone is interested in working on the event, contact either me at the address at the end of this column, or Lisa Martin at: 1 Toms Point Lane #81, Port Washington, NY 11050. We welcome any ideas as well!

David Topping completed an MS in geology in the Department of Geological Sciences at the University of Washington in March 1991. He is currently working toward a PhD in the field of sediment transport in the same department.

Jimm Gauding received an MS from MIT's linguistics department in June 1990. She joined the Teach for America Program and spent a summer training in L.A.'s year-round schools. She is currently teaching life science in Junior High School 117 in Brooklyn, N.Y. She plans to fulfill a two-year commitment there.

Kevin Oliveira spent the summer working for Nabisco. He is attending law school in Williamsburg, Va. **Craig Jungwirth** is still with Disney Corp. and maintaining incredible hours working on a Space Mountain project.

I hope to hear from more of you for our next issue!—**Grace Ma**, secretary, 545 1st Ave. #7R, New York, NY 10016, (212) 447-1925

89

Well, it's the end of the summer, and there are a few weddings to report, but not too many vacations—so drop a card and let us know about your holidays!

On Sunday, July 14, **Anuradha Vedantham** and **Renganathan Iyer**, G '91, were married in a traditional Indian wedding in Cherry Hill, N.J. Helping them celebrate were **Anjali Arora** (who is in the Robert Wood Johnson Medical School, formerly Rutgers, in New Jersey), **Susmitha Bellam** (who is working at AT&T in Holmdel, N.J.), **Rosina Samadani** (who is in MIT grad school), **John Mandeville** (who is at the Columbia College of Physicians and Surgeons in New York), **Irene Sckricki**, **Suja Varadarajan**, '90, **Priyamvada Natarajan**, '90, **Renee Miller**, '87, **Andrea Wasem**, '87, **Geetha Krishnan**, '93, and MIT graduate students **Ron Baakkonen**, **Murola Kodialam**, **Rama Gopalan**, **Shampa Chanda**, **Prakash Mirchandani**, **Rama Krishnan**, **Kavita Rajan**, and **Adil Abdulah**. **Anu** will be joining Irene in the fall at the Woodrow Wilson School of Public Policy at Princeton University.

Renee Oatway was married to Satogiro Akimoto on June 9. **Grace Tseng**, '90, **Liz Ling**, '90, and **Nina Chen**, '90, were in the wedding party. Also at the wedding were **Claudio Chamon**, who is currently in the ultrafast group at MIT, and **Harry Sverdløve**. . . . **Cheryl Blake** is stationed at Rome Air Force Base in New York. Cheryl now owns her own catamaran, and has been sailing a lot this past summer. Cheryl plans on applying to grad school in a few years. **Dan Pless** is working in Philadelphia. . . . **Jim Reich** is living in San Diego. . . . **David Jedlinsky** was working in Switzerland until August, designing an operating system for a company. David journeyed to Disneyworld for a week's vacation this summer.

Ross Levinsky is in Ghana and will forward more information soon. . . . **Kristina Holly** recently won the MIT 10K Competition for the best business plan. Kristina and her business partners submitted a business plan for a grocery delivery

company, Dial-a-Fish, where shoppers use a wand and bar code book to order groceries. A major supermarket has agreed to test the system on a trial basis. Kristina is finishing an MS at MIT this summer, and after graduation will work full-time in the new business. . . . After returning from a year in Tokyo, **Angelina So** is now employed at IBM in Poughkeepsie, N.Y. She has been keeping active in tennis, volleyball, and soccer while also taking graduate courses at Columbia University via satellite.

Curtis Chen is joining Oracle. . . . **Michael Chung** recently moved to a new place in Columbus, Ohio. Michael recently visited **Andy Yee**, who is in grad school at Northwestern. . . . **Eric Eileras** has decided to return to school. He will be attending Northwestern's School of Management in the fall, where he will be studying management and manufacturing in a two-year program. . . . **Shirley Chang** has accepted a permanent position with GE Plastics in Albany, N.Y., after two years of rotations throughout the company on GE's Chemical/Materials Program.

Craig Cohen is doing ASIC design work at Sun Microsystems. He has been staying in touch with a group of Theta Deltas via poker games, parties, and occasional road trips. The poker group includes: **Greg Belaus**, '88; **Tom Esselman**, '85; **Ethan Joffe**, **Micah Adler**, '90; **Tom Nichols**, '87; **Zain Saidin**, '90; **Boris Zimmelman**; and **Mark Pimone**, '83. **Tom Darci**, '87; and **David Gessel** make appearances at local parties. Craig also saw **Alan Foonberg**, '85, **Dan Lane**, '85, and **G. Mark Brown**, '85, on a recent LA roadtrip. . . . **Sondra (Swenson) Martinez** graduated with the Class of '90 after taking some time off in 1987 to work for a while. Sondra is now attending graduate school at Arizona State University in geology, and is expecting to graduate with a PhD in three more years. Sondra was originally planning to study atomic force microscopy, but after a semester, decided to change to metamorphic petrology, and is now working with Prof. Simon Peacock, G '81. Sondra married **Lorenzo Martinez**, '86, three years ago, and things are going pretty well for them. Lorenzo is now working with the Arizona state legislature as a fiscal analyst, and the two of them are living in Tempe, Ariz.

David Goldstone presented a paper in July at the National Conference for Artificial Intelligence, which was held in Anaheim, Calif. David didn't go to Disneyland, but did see a lot of old friends. He stayed with **Josh Wachman**, '90, who is working for Disney, and with **Michael de la Maza**, '92, who presented a paper at a workshop. Dave also saw **Erik Ordentlich**, who drove down from Stanford for a couple of days. Erik and Dave visited the La Brea tar pits and checked out the scene in Westwood, home of 14 (!) first run movie theaters. They also went to Venice Beach and Muscle Beach to catch some rays. "Still, it was nice to get back to Texas," David writes. **Bill Jarrold** and he have been catching some local bands in Texas; Austin has a great local music scene. David will be leaving Austin and IBM in mid-August and heading to Philadelphia for law school.

After graduating from MIT, **Laird M. Malamed** went to the USC Graduate School of Cinema-Television to work on an MA. Things have been going very well, and Laird has decided to concentrate in post-production sound for film and television. (David, '85, **Bill Spitzak**, '83, and **Mark De Cew**, '84, also went this route while at USC film school, Laird writes.) . . . Late in May, Laird was approached by his boss in the Sound Department (where he was a T.A.) and he asked if he would give up his degree if a full-time job availed itself. Laird writes that "Being cautious (it was 9:00 am and I was sick, so these life determining questions were not high on my agenda for fun), I answered that it would depend on the job. He said that George Lucas was looking for another Ben Burtt. Ben, who is well-known in the industry, went from USC directly to work on 'Star Wars' with George when Ben was 24. In the past 15 years, he has won three Oscars for his

work on the Star Wars films, the Indiana Jones trilogy, and E.T. Recently, he just directed 'Blue Planet' for IMAX. I of course said that I would certainly consider leaving film school for this opportunity. So, I was sent to San Rafael where Lucas has a ranch for an interview. I met with George and Ben, and I guess they liked me as I was offered the job of assistant supervising sound editor on the 'Young Indiana Jones' television show. The show follows Indy and his father, Henry, as they travel around the world in the 1910s. It will air Monday nights starting in January."

Laird's main responsibilities will be locating and creating sound effects as well as doing music research for all the different countries the Joneses visit. For his degree, Laird actually only has a thesis left to complete a master's, and he has until 12/93 to finish it. The job is only definite through September 1992, so he may have time when the job is over.

Cindy Wang went down to Orlando, Fla., last week and met up with **Vivian Liu**, Sylvia Liu (Yale, '91), **Dave Gebala**, and Alex Caro, '90. They went to EPCOT center and MGM studios. Dave, who got an MS in June from MIT, started his new job at Motorola in Ft. Lauderdale as an advanced manufacturing engineer in the beginning of August. Cindy also writes that **Laura Brauer** has joined a new group within GE in East Windsor, N.J. She's a mechanical engineer in Launch Operations, a very exciting job which entails frequent trips down to Cape Canaveral and French Guiana for launch missions.—**Henry Houh**, secretary, 4 Ames St., Cambridge, MA 02139, e-mail: tripleh@athena.mit.edu or henryhouh@mit.edu

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Congratulations to **Chris Fennema** and Randy Notestine, '89! They were married on August 10 at the Minnesota Landscape Arboretum in Chanhassen, Minn. They held a reception immediately following the wedding at the Braemar Golf Club in Edina. The celebration in Edina went on well past midnight. At the reception, I spotted Bakerites **Debbie Bein**, Galia Meiri, '89, and Tim Sulzbach, '89. Other MIT alumni included Joe Beninato, '89, Beth Fellingham, '89, Joe Jones, '89, **Jennifer Hamil Jones**, Kevin Moschetti, '89, **Pete Roelstead**, Scott Schwartz, '89, **N. Baht G.**, and **Wilson Tseng G.** After the wedding, while I waited at the airport for a flight back to the East Coast with Debbie and Tim, we spotted Mark Lubratt, '89. Mark will soon be working for 3M in Minnesota.

Congratulations also to **Ariana Yuen!** Ariana is currently working on a master's degree in mechanical engineering at MIT, but she flew back home to Hawaii for her wedding. She was married on July 20 to Sean McDonough.

Still attending school, we find a number of dedicated people. . . . **Robert Dodd** is in his second year at Stanford Medical School. . . . **Jerry Lukpat** is working toward a PhD in electrical engineering at Stanford. . . . **Erica Kuo** is also working for a PhD. She is studying chemistry at Berkeley. . . . **Irene Kuo** is back in her hometown of San Francisco, attending the University of California at San Francisco Medical School. . . . **Andrew Sutherland** is an NSF graduate fellow in the mathematics department at MIT. He's working toward a PhD in the theory computation group. . . . **Trung Nguyen** is attending Cornell graduate school in the department of computer science. . . . **Jessica Tornell** is finishing up a master's at Stanford.

Sabina Ahmed writes that she and **Melinda Su** are both working at Deloitte and Touch in San Francisco. Sabina has become an active member of the MIT Club of Northern California. She has organized a Sloan School Club to represent MIT at the Joint Business School Forum in the Bay Area with other clubs such as Harvard, Stanford, Wharton, Kellogg, Cornell, and Tuck. . . . Also working in the Bay area are **Shanthi Muthiah**, **Sophia Mangatal**, and **Arturo Zacarias**. They are

all working at Oracle and live on the peninsula.

. . . **Vandita Malviya**, who is also in the Bay area, is working for Genentech. . . . Sabina has also brought us news on a couple of other people. **Tunay Kuru** spent the summer working at the Washington University Medical School at St. Louis. . . . **Mark D'Agostino** is working in Washington, D.C., for SPA, but his job keeps him out of town a lot—mainly in Canada. . . . **Lisa Lozo** works in Miami. . . . **Alice Chang** has just moved to Mountain View. . . . **Vivek Rastogi**, who shares an apartment in Menlo Park, Calif., with Arturo Zacarias, works for Hewlett Packard.

Janet Fordunski seems to be having fun out in San Diego. She writes that when she's not scuba diving, she's working as a design engineer in building public improvements in the San Diego area. Janet mentions that she doesn't miss Boston much—well, except for the ice hockey! . . . **Mark Edelson** has recently returned from Saudi Arabia. He served there for seven months with the Navy Seabees, constructing advance bases for the U.S. Marine Corps. His projects included 2 million square feet of runway, 100 acres of ammunition storage sites, 200 miles of roads, and housing for 20,000 marines. Mark is currently in California.

. . . **Mark Strong** is living in Novi, Mich., and working on brake systems development for General Motors. . . . And back here on the East Coast, **Toby Sanders** and **Julie Temple** are sharing an apartment in Manhattan. Toby is getting a master's at Columbia's Teacher's College in communications, and Julie is working for Morgan Stanley in the Information Systems Department.

Robert King is working as an engineer for Lockheed Missiles and Space Co. in Sunnyvale, Calif. He's sharing an apartment in Campbell, near San Jose, with his twin sister Suzette. However, he makes frequent trips to Sacramento, Reno, and Lake Tahoe. Robert met up with Mike Gesner, '89, in Boston a while ago to take Kathy Nothnagle, '92, bar hopping for her 21st birthday. Earlier this spring, Robert and Mike met again in Cancun for a short vacation. Mike is working for Pratt & Whitney in West Palm Beach, Fla. Robert also brings us lots of other news. . . . **Scot Griffin** is attending law school in San Francisco. . . . Congratulations to **Ron Logan!** He has just gotten engaged to Julie Fernandes. They are planning for a June '92 wedding. Ron is working as a computer network administrator in Sacramento and will be back in school in the fall of '91.

Joanne Spetz has moved out to Mountain View, Calif. . . . **Joe Babiec** spent the summer running around Europe and trying to get research arranged for the coming school year. He will probably be moving to London soon. . . . Best wishes to **Stacey Seagal!** Stacey is engaged (or is it married by now?).

The MIT Reinhold Rudenberg Memorial Prize has just been awarded to **Jeff Kalt** for his undergraduate thesis relating to energy conversion. Jeff's award included a \$1,000 cash prize. His study, "Absolute Charge Sensor Measurements of Flow Electrification in Couette Charger," was selected by MIT's Laboratory of Electromagnetic and Electronic Systems for its measurement of electrical charges in various transformer oils. Jeff currently works as an R&D engineer at Space Systems/Loral in Palo Alto. He is developing automated test equipment for power systems to be used in the Space Station Freedom. Congratulations Jeff!

Remember our class gift? As of mid-May, a meeting with an architect from Harvard was being scheduled. The architect has had experience in clock tower design. Once I get more information on this, I'll pass it along. . . . **Tami Jacobsen** and I are still working at IBM in New York. We're finally done with our year of training! Tami has just finished up her classes in large systems and I've just finished up my workstation classes. Back in July, Tami took some time off to vacation in Hawaii. . . . What did everyone else do for the summer? Send news to—**Ning Peng**, secretary, 10140 Creekwood Circle, Plymouth, MI 48170, (212) 745-2704 (work)

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I CIVIL ENGINEERING

Drew Persinko, SM '79, sends word from Derowood, Md.: "I am a senior engineer with Tenera, L.P. We provide consulting services to the commercial nuclear power industry and Department of Energy nuclear facilities." ... **Scott Nason**, SM '77, has been named VP for operations and planning by the American Airlines board of directors. Nason, who joined Fort Worth, Tex.-based American in 1980 as a senior analyst of operations research, will be responsible for crew scheduling, dependability analysis, operations engineering, and system operations control. ... **David A. Dzombak**, PhD '86, assistant professor of civil engineering at Carnegie Mellon University in Pittsburgh, Pa., received a Presidential Young Investigator Award from the National Science Foundation. The award recognizes his research and teaching accomplishments in environmental engineering. PYI awards are made to about 200 outstanding young faculty members per year across the U.S. in all branches of science and engineering. An award includes commitment of base support for the awardee's research for five years. ... **Feniosky Avelhermi Pena**, SM '91, a doctoral candidate in Course I, has been awarded a Ford Foundation pre-doctoral minority fellowship. Predoctoral Fellowships provide funds for stipends and tuition for three years of tenure. In sponsoring these fellowship programs, the Foundation "endeavors to support scholars in achieving their full potential and in attaining greater recognition in their respective fields."

II MECHANICAL ENGINEERING

Bascom W. Birmingham, '48, SM '51, retired director of the Boulder Laboratories of the National Institute of Standards and Technology (formerly the National Bureau of Standards), has been awarded the Collins Award at the 1991 Cryogenic Engineering Conference in Huntsville, Ala. The award, named for MIT Professor Samuel C. Collins, was established in 1961 to recognize those persons who, like Collins, made contributions to the field of cryogenics that were of great significance. Birmingham was honored for "his pioneering work with large scale hydrogen liquefaction systems, his management of a diverse national program in cryogenics at the National Bureau of Standards, and his continued leadership over three decades in the cryogenic engineering field." He is only the fifth person ever to receive the Collins Award. Birmingham began his career at NBS in 1951 at the then new Boulder site. He served there as director from 1971 until his retirement in 1983. He currently serves as a consultant in the cryogenics field. ... **Bjorn Qvale**, '62, SM '63, PhD '67, professor at the University of Denmark at Lyngby, has been named a Fellow of the American Society of Mechanical Engineers. He is a member of the Society of Automotive Engineers, AAAS, American Society of Engineering Education, and Norwegian Engineering Society. ... **Francis De Winter**, '58, SM '60, ME '61, has edited *Solar Collectors, Energy Storage, and Materials* (MIT Press, 1990). The book is comprised of 26 chapters that

"emphasize the modeling and assessment of devices rather than their application or cost," states the book jacket. De Winter is president of the Atlas Corp. in Santa Cruz, Calif., and is a member of the Santa Cruz Energy Advisory Committee.



J.P. Barger



W.M. Rohsenow

J.P. Barger, '50, SM '56, has been named chair of the board and CEO by the Dynatech Corp. Barger replaced **Warren M. Rohsenow**, who is now honorary chair of the board and director. Barger and Rohsenow, who co-founded Dynatech in 1959, have both been employed at MIT. Barger was an assistant professor of mechanical, chemical, and nuclear engineering and Rohsenow, professor emeritus in Course II, was the director of the Heat Transfer Lab at MIT. ... **Carl Curtis Koch**, SM '64, professor in the Department of Materials Science and Engineering at North Carolina State University in Raleigh, N.C., has been named a Fellow by ASM International. He was cited for "pioneering research in solid state amorphization by mechanical alloying, and for contributions to understanding ductilization of intermetallic compounds and the role of defects in improving the properties of superconductors." ... **John W. Holmes**, SM '83, PhD '86 (III), assistant professor in the department of mechanical engineering and applied mechanics at the University of Michigan in Ann Arbor, Mich., and **Frank A. McClintock**, Course II professor at MIT, are the 1991 recipients of the Henry Marion Howe Medal. The award, established in 1923 and given by ASM International, honors the author (or authors) whose paper has been selected as the best of those published in a specific volume of *Metallurgical Transactions*.

III MATERIALS SCIENCE AND ENGINEERING

Joseph I. Goldstein, '60, SM '62, ScD '64, the R.D. Stout Professor of Materials Science and Engineering at Lehigh University, recently received the 1991 Presidential Science Award from the Microbeam Analysis Society (MAS). Goldstein was honored for "his contributions to the fields of analytical electron microscopy, the use of microbeam analysis techniques in experimental determination of diffusion properties, the application of microbeam analysis techniques to important problems in materials and meteoritical science, and for his outstanding achievements as an educator in electron microscopy and microbeam analysis." One of the founding members of MAS, Goldstein served as the organiza-

tion's president in 1977. ... **Janet Rankin**, PhD '89, and **Lynn Boatner**, researchers in the Oak Ridge National Laboratory's Solid State Division, recently received a second-place award in the ceramographic competition at the 1991 American Ceramic Society Annual Meeting and Exposition. They earned the award in the optical microscopy category for their entry entitled "Cavitation-Induced Fracture of MgO." The researchers competed against more than 40 entries from universities, industry, and other national labs. Their award-winning entry presented results in the form of optical micrographs in which fracture effects on an MgO ceramic material were delineated and studied. While such damage has been extensively studied on metals and alloys, Rankin and Boatner are among the first to investigate cavitation damage in ceramic materials.

ASM International has installed the following into their 1991 class of Fellows: **Steven S. Hansen**, '73, SM '75, ScD '78, supervisor of the Steel Products Division at Bethlehem Steel Corp.'s Homer Research Laboratories in Bethlehem, Pa., for "outstanding contributions to the fundamental understanding of the physical metallurgy of microalloying and dual phase technology." ... **Gregory J. Hildeman**, ScD '78, manager of the molten Metal Processive Division at Alcoa Laboratories in Alcoa Center, Pa., for "outstanding contributions to the development of high-strength powder metallurgy aluminum alloys for structural applications at room temperature and high-temperature dispersion strengthened aluminum alloys."



P.A. Gault

Paul A. Gault, '82, SM '82, has been named section manager of scheduling and logistics at The Timken Company's Faircrest Steel Plant. Gault joined the Canton, Ohio-based company in 1982 as a research engineer and most recently served as area manager of ingot making in the Fieldcrest Plant. ... **William R. Prindle**, ScD '55, division VP and associate director of the Technology Group at Corning, Inc., in Corning, N.Y., for "significant contributions to the R&D of ceramic and glass production and application technologies." ... **Visvanathan R. Subramanian**, SM '69, EE '69, director of the Indian Lead Zinc Information Centre in New Delhi, India, for "significant contributions to the development of improved welding equipment and techniques particularly for applications involving surface coatings on ferrous and non-ferrous alloys." ... **Jeffrey Walman**, ScD '67, chief of the Advanced Metallic and Ceramic Materials Branch of the Aerospace Materials Division at the Naval Air Development Center in Warminster, Pa., for "the development and application of innovative thermal mechanical treatments of advanced aluminum alloys for aerospace systems."

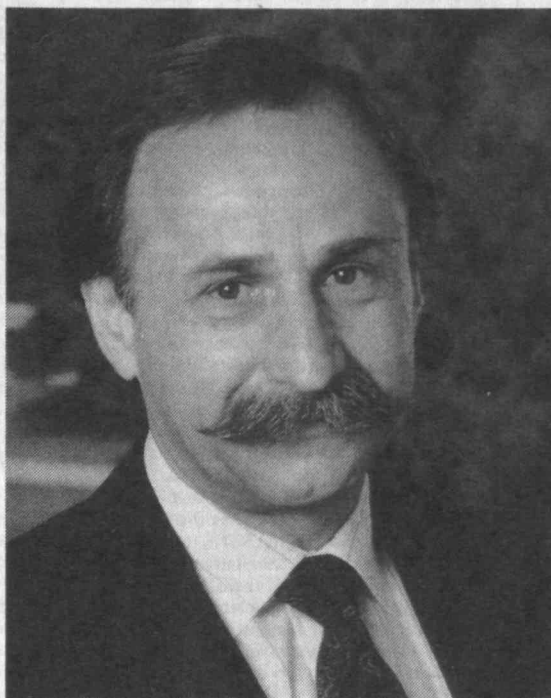
ASM International has also given the following awards: **Andreas Mortensen**, PhD '86, the Alcoa Associate Professor in Course III at MIT, and **Véronique Michaud**, PhD '91, Course III postdoc-

MIT-Trained Metallurgist at Carnegie Mellon's Helm

Take one look at Robert Mehrabian's record, and you can imagine why he was elected Carnegie Mellon's new president by unanimous vote in April of last year. An internationally recognized materials scientist, Mehrabian received both a bachelor's degree ('64) and a doctorate (ScD '69) in metallurgy from MIT. He has held faculty positions at MIT and the University of Illinois, spent four years at the National Bureau of Standards, and is the founder and director of Superconductors Technologies, Inc., a Santa Barbara-based company that produces devices using high-temperature superconductors. He holds eight patents as co-inventor of metalworking and composite fabrication processes, and received the Henry Marion Howe Medal of the American Association of Metals. Most recently, from 1983 to 1990, he served as dean of the College of Engineering at the University of California at Santa Barbara.

Robert Mehrabian was born in Iran, in 1941, to Armenian parents. In school he learned subjects in Armenian, English, and Persian, and then spent his senior year of high school at Phillips Exeter Academy in New Hampshire. Despite the initial language difficulties, he was able to succeed at college-sophomore-level math and science courses. At MIT, the dynamic Mehrabian was an outstanding student, researcher, and professor, according to Merton C. Flemings, '51, Mehrabian's thesis advisor and now head of the Department of Materials Science and Engineering. Mehrabian did major work in solidification, macrosegregation, and rheocasting, as well as developing some new undergraduate subjects.

Perhaps his most noted accomplishment, though, is his recent tenure as dean at Santa Barbara, where Mehrabian was "aggressively successful," in the words of MIT Corporation member Robert Charpie, also chair of the Carnegie Mellon board. Credited with leading the College of Engineering to national prominence, Mehrabian



Robert Mehrabian

achieved a near reconstruction of the school: more than 65 new faculty members, seven new research centers—in areas such as robotics, high-performance composites, and compound semi-conductors—a new doctoral program in materials science, a new engineering building, and a seven-fold increase in the college's budget, all in only six years.

Not surprisingly, when asked about him, Mehrabian's colleagues and friends describe a hard-working, energetic, intelligent, and intense man. MIT Professor of Materials Science and Engineering Kent Bowen, PhD '71, notes that Mehrabian has created teaching and research programs wherever he has gone, and called him a "tremendous builder" and "one of those rare people who thrives on a mess."

Carnegie Mellon, however, is hardly a mess. An international school known for computer science and research, the university is also distinguished for its strong departments in humanities as well as sciences. In fact, one might wonder whether Carnegie Mellon needs a Robert Mehrabian. But his abilities go beyond his reputation

as a builder and a fixer. In a *Carnegie Mellon Magazine* interview, Mehrabian stated that it was not what the school needed but what it had to offer that attracted him to the position.

This isn't to say that Mehrabian has no plans for Carnegie Mellon. Currently on the agenda are several new buildings, including a university center, an electronic materials technology building, and a performance center, as well as renovations on existing labs and the gymnasium. In response to the decline in defense spending, he plans to redirect some of the university's resources to address issues such as the environment and manufacturing competitiveness.

Mehrabian is not focused entirely on facilities and programs. He has a vision of multidisciplinary students, educated in both humanities and sciences, who, in the future, "are going to participate in an environment that's going to be information-intensive, global in nature, and multicultural." He speaks of maintaining the university's strength in computing while exploiting the College of Fine Arts; fueling research programs while improving undergraduate education. The university will seek more money from private sources, which will be used to improve life on campus. He would also like to increase the numbers of minority and women students on campus.

The key to Mehrabian's success is an ability to look at a situation from all angles and consider all points of view, to avoid rash decisions, and to rely on the talents of his colleagues. He has said that "it is critical to have the best people running the institution and not to try to run the institution by oneself," and Kent Bowen concurs. "Mehrabian gets tremendous loyalty from the people around him," says Bowen. "His stated philosophy is that he always looks to hire people who are smarter and better than he is." That'll be tough.—Anne Detweiler □

The author, a former Technology Review staff member, is now circulation director at Sloan Management Review.

toral research associate, have been awarded the Marcus A. Grossmann Young Author Award. The award, established in 1960, honors the author(s) under 40 years of age whose paper has been selected as the best of those published in a specific volume of *Metallurgical Transactions*.

David J. Duquette, PhD '68, professor of materials engineering at Rensselaer Polytechnic Institute in Troy, N.Y., has been awarded the 1991 Alpha Sigma Mu Lectureship for "Relationship Between Plastic Deformation and Corrosion Processes in Environmental Cracking of Metallic Materials." This award recognizes excellent scholarship and achievement in materials science and engineering. . . . **Praveen Chaudhari**, SM '63, ScD '66, who works at IBM Corp.'s T.J. Watson Research Center in Yorktown Heights, N.Y., was awarded the ASM/TMS Distinguished Lectureship in Materials and Society for "Materials Science and Engineering in the 1990s." The award, established in 1971, "clarifies the role of materials engineering in technology and in society in its broadest sense: to present an evaluation of progress made in developing new technology for the ever changing needs of technology and society, and to define new frontiers for materials engineering." . . . **Gilbert Y. Chin**, '59, ScD '63, retired director of the Passive Components

Research Laboratory at AT&T Laboratories, was posthumously presented the Edward Demille Campbell Memorial Lectureship.

IV ARCHITECTURE

Samuel C.M. Wang, MAR '62, is corporate architectural officer at Boston-based Chas. T. Main, Inc. Previously, he was senior VP with Cannon also in Boston. . . . **Henry S. Reeder, Jr.**, '63, has been



H.S. Reeder

many buildings across the country including making renovations to Building 10 and Building NW 17 at MIT.

Ralph Gakenheimer, Course XI professor, **Stanford Anderson**, Course IV professor, and **George Pillorgé**, '60, vice-chair at RTKL Associates in Baltimore, Md., were involved in an urban design project sponsored by the City of Paris. Calling themselves the RTKL team, they participated in a design consultation to extend the historic axis of Paris west of the Grand Arch at La Défense. Out of a field of 92 international teams, they were among the 10 finalist teams. Although the RTKL team's design wasn't selected, there is a possibility of being involved in the actual design down the road.

Alfred Edwards, MCP '46, of Franklin, Mass., died on July 7, 1991. Edwards was employed by the city of Fall River, Mass., for 30 years, retiring in October. He was a member of the American Association of City Planners. . . . The Alumni/ae Association has been notified that **Gilbert Earl Hoffman**, MAR '39, of Keystone Heights, Fla., died on May 14, 1981. There was no further information provided.

V CHEMISTRY

James Lefferts, PhD '76, writes: "Kris and I are still happily living in Mitchell. I have just been promoted to the rank of associate professor of chemistry at Dakota Wesleyan University. Kris will be finishing a master of nursing degree at South Dakota State this fall." . . . **Paul Cartier**, PhD '88, sends word: "After three interesting and enjoyable years at Polaroid Corp. in Cambridge, I have joined the charter faculty of a new (English-language) university, the Hong Kong University of Science and Technology. My responsibilities will include teaching and research in organic chemistry."

Gerald D. Laubach, PhD '50, retired former president & COO at Pfizer, Inc., is now on the board of directors at DNA Plant Technology Corp. in Cinnaminson, N.J. . . . **Carlos "Chuck" Wilkerson**, PhD '73, has been appointed instructor at Jefferson Medical College of Thomas Jefferson University, and a member of the medical staff of Thomas Jefferson University Hospital. Wilkerson's area of specialization is anesthesiology. . . . **John Groves**, '65, a member of the Princeton Chemistry Department since 1986 and currently department chair, has been given the Hugh Stott Taylor Chair of Chemistry. Groves,

who was at the University of Michigan for 16 years before joining the Princeton faculty, does research on the action of metalloenzymes.

Arnold M. Karo, PhD '53, of Pleasanton, Calif., died on June 16, 1991. Karo was a senior research scientist in theoretical and solid-state chemistry and physics at Lawrence Livermore National Lab for 33 years. He was the author or coauthor of more than 200 scientific publications and national and international conference presentations in atomic and molecular physics, theoretical chemistry, and solid-state physics. . . . **Gerald L. Goe**, PhD '67, died on July 9, 1991. Goe, a specialist in pyridine chemistry, had been director of research at Reilly Industries, Inc., in Indianapolis, Ind., since 1980. He had done research and published numerous articles in the areas of heterogeneous catalysis, synthesis of heterocyclic compounds, and organic photochemistry. Goe served as assistant professor of chemistry at the University of Notre Dame from 1969 to 1973. . . . **John Charles Karris**, SM '84, of Haverhill, Mass., died on June 18, 1991. He had been employed as an editor with the Glenco Publishing Co. in Westerville, Ohio. Karris graduated from Bowdoin College, where in 1979 he was designated the James Bowdoin Scholar. . . . The Alumni/ae Association has been notified that **Milton Yusem**, PhD '44, of Oak Park, Ill., died on April 28, 1991. There was no further information provided.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Robert P. Kaiser, SM '56, writes: "While still active in my consulting company, Argos Associates, Inc., I have become more and more involved in Hi-Seas Industries, Inc., a company founded by my brother that supplies gear to the commercial fishing industry. Madeleine and I have one son, Pierre, who is an undergraduate at Stanford, and a daughter Martine, now a high school senior looking at various colleges." . . . On July 1, 1991, **Leonard Kleinrock**, SM '59, PhD '63, became chair of the Computer Science Department at UCLA. . . . **Bernard Widrow**, '51, SM '53, ScD '56, is one of three recipients of the 1991 IEEE Neural Networks Council Pioneer Award. 1991 marks the first year for this award, which is to be presented annually to outstanding individuals for contributions made at least 15 years earlier. Widrow was honored for his work on adaptive networks. Widrow is professor of electrical engineering at Stanford University where he has been on the faculty since 1959. His pioneering work includes the development of the Adaline (Adaptive Linear Neuron), the Madaline (Many Adaline) network, the LMS training algorithm (often called the Widrow-Hoff delta rule), and studies of applications in such diverse fields as electrocardiogram analysis and adaptive control.

Nathaniel Fisch, '72, SM '75, PhD '78, has been appointed to professor of astrophysical sciences with tenure at Princeton University as of July 1, 1991. He has worked at the Princeton Plasma Physics Lab since 1978, when he was appointed research associate. In 1983 he advanced to research scientist. He was named lecturer with the rank of associate professor in 1987 and lecturer with the rank of professor in 1989, the same year in which he was promoted to principal research scientist. Fisch holds six patents and has published over 50 articles. . . . **Suhaz Patil**, SM '67, ScD '70, and **Charles A. Zraket**, SM '53, are two of five members named to the board of directors at the Computer Museum in Boston. At the world's only computer museum, the directors oversee the museum's long-range planning and implementation, and fundraising activities. Patil is chair of the board and executive VP for Products and Technology at Cirrus Logic, Inc., in Milpitas, Calif. Zraket is currently Scholar-in-Residence at

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the Kennedy School of Government at Harvard University. He is also a trustee and past president and CEO of the Mitre Corp. . . . Three MIT alums were awarded medals by the IEEE. **Anton Haus**, ScD '54, Institute Professor at MIT, was awarded the Education Medal for "creative contributions to education in electromagnetic fields and waves, and quantum electronics." **Paul E. Green, Jr.**, ScD '53, manager of advanced optical networking at IBM/T.J. Watson Research Center in Yorktown Heights, N.Y., received the Simon Ramo Medal for "the introduction of modern system techniques to the interpretation of seismic waves, and the application of these techniques to distinguishing earthquakes from underground nuclear explosions." **Elwyn Berlekamp**, '62, SM '62, PhD '64, professor of mathematics and electrical engineering-computer science at the University of California at Berkeley, was awarded the Richard W. Hamming Medal for "profound contributions to the theory and application of error-correcting codes." . . . **Stephen J. Jatrass**, SM '52, who in December 1990 retired as chair of the Memorex Telex Corp. in Tulsa, Okla., has been named a member of the board of trustees at the University of Tulsa. . . . **Don Fuqua**, SM '84, president of Aerospace Industries Association of America, Inc., in Washington, D.C., has been named a distinguished life member of ASM International. Such membership is conferred upon those leaders who have devoted their time, knowledge, and abilities to the advancement of the materials science and materials engineering industries. . . . Another ASM International honoree is **Visvanathan Subramanian**, SM '69, EE '69, director of the Indian Lead Zinc Information Centre in New Delhi, India. He was named an international Fellow for "significant contributions to the development of improved welding equipment and techniques, particularly for applications involving surface coatings on ferrous and non-ferrous alloys."

VI-A INTERNSHIP PROGRAM

Writing this in August, for the November/December issue, at least portends the end of hot, humid weather which has plagued the Boston area on several occasions this summer. Yes, it hit 100° at my home in Wellesley. I always looked forward to the summer visits to VI-A companies, a function now handled by Director **Kevin J. O'Toole**, SM '57, NE '57 (XIII). These give a chance to observe, firsthand, the quality and challenge of assignments provided by our participating companies and the degree to which they integrate VI-A students into the industrial environment they will eventually enter. Mr. O'Toole's travels, so far, have taken him to the Naval Surface Warfare Center in Washington, D.C., the Schlumberger sites in Austin and Houston, Tex., Texas Instruments in Dallas, and to N.J. to visit AT&T Bell Labs and Bellcore. The Dallas trip coincided with the annual VI-A Luncheon hosted by **Cecil H. Green**, '23, SM '24, a founder of Texas Instruments and member of MIT's Corporation. Cecil uses the occasion to give the students some words of inspiration and to tell management, which is also present, how important he regards TI's participation in the program. We congratulate Cecil who celebrated his 91st year in August.

During the N.J. visit VI-A hosted a dinner for AT&T and Bellcore students and representatives and advisor, Professor **Frederic R. Morgenthaler**, '55, SM '56, PhD '60. Kevin's overall assessment is that "our students have some very interesting assignments, and are being challenged, and are enjoying the change of pace from the MIT routine."

Professor Emeritus **J. Francis Reintjes** (VI-A director, 1960-69), has written a book entitled *Numerical Control: Making a New Technology*

(Oxford University Press). Reintjes was a director of the former Servomechanisms Laboratory (later named the Electronics Systems Lab and now called Laboratory for Information and Decision Systems). The Servo Lab pioneered the development of numerically controlled machine tools and to what followed, the present field of computer-aided design (CAD).

The Information Systems Group, of MIT's Sloan School, has ranked at the top of three recent surveys. The group is headed by **Stuart E. Madnick**, '66, SM '69, EE '71, PhD '72, the John Norris Maguire Professor of Information Technology. The surveys were done by *Computerworld*, the University of Maryland, and *U.S. News & World Report*.

Visitors to the VI-A office, since I last wrote, have included the following. **Richard E. Anderson**, '87, SM '87, with whom I had a nice chat. Andy is employed by NCR and lives in Norcross, Ga. . . . I had a talk with **Steven L. Bates**, '74, SM '76, EE '76, and he tells us he still lives in Concord, Mass., and works for Tau-Tron, Inc., in Westford, Mass. . . . **Geoffrey J. Bunza**, '74, SM '77, EE '78, PhD '81, called and brought me up to date on his latest work at Mentor Graphics in Beaverton, Ore. . . . **Daniel M. Sable**, '80, dropped in during a visit to Boston from Virginia where he's a research associate on a project at VPI doing work for his PhD thesis.

Plans are moving ahead for the Department's celebration of VI-A's 75th Anniversary in June 1992. Our activities will be held in conjunction with MIT's Alumni/ae Week. A special fall mailing will inform you all of the plans, but those of you far away may wish to start thinking about travel and vacation plans. We're still seeking ideas of interest from VI-A alumni/ae, but they must be fed back very shortly to be incorporated in our plans.—**John A. Tucker**, director (emeritus), VI-A Program, MIT, Rm. 38-473, Cambridge, MA 02139-4307

VII BIOLOGY

Iva Greenwald, PhD '83, has been promoted from assistant professor to the tenured position of associate professor in the Department of Molecular Biology at Princeton University. Greenwald joined Princeton in 1986. "One of the fundamental problems in developmental biology," she says, "is how many different cells types are generated during the development of an animal from a unicellular zygote. I work on this problem in a nematode that is particularly tractable to genetic analysis." Greenwald teaches developmental genetics, and she has been involved in her department's ongoing revision of the introductory biology labs.

VIII PHYSICS

Matthew J. Mayberry, PhD '86, sends word from Los Altos, Calif.: "Since graduating from MIT I have been working at General Atomics in San Diego as a research scientist in the DIII-D experimental plasma fusion program. Last September I started attending Stanford in the full-time MBA program to pursue a career in high-tech commercial product development." . . . **Joseph S. Broz**, '80, of Zurich, Switzerland, and formerly of Denver, Colo., has been awarded a 1991-92 White House Fellowship. Broz, a physicist and energy technology consultant, was selected as one of the 16 White House Fellows in recognition of his leadership, professional and intellectual achievements, and dedication to his community. As a White House Fellow, Broz will serve a one-year assignment as a special assistant to the presidential science advisor in the Office of Science & Technology Policy at the White House. He will

also participate in an education program which will include meetings with government officials, scholars, diplomats, journalists, and leaders of business and industry. As an undergraduate, he founded an energy research consulting practice where he developed five patent-applied operating methods for enhancing oil recovery from depleted petroleum reservoirs. In 1985, Borz assisted in founding a joint U.S.-French public company for the production of ultraporous membranes utilized in semiconductor manufacturing. He was Scientific Advisory Board Chair and co-directed product research until the public underwriting in New York in early 1989. . . . **Allan D. Pierce**,



A.D. Pierce

include structural acoustics, opto-acoustics, underwater sound, atmospheric acoustics, and computational acoustics.

X CHEMICAL ENGINEERING

W. Henry Tucker, SM '46, ScD '47, writes: "Beth and I are now retired in Salem, Ore. I am active in promoting World Neighbors, Inc., in self-help (people-centered) development in the Third World. I am also writing a study booklet for churches on Third World Development. . . . **Max N.Y. Lee**, SM '58, sends word from Yorktown Heights, N.Y.: "I formed a new company called Global Strategic Enterprises, Inc. I am acting as chair and president of the company." . . . **Julian T. McKinnon, Jr.**, PhD '89, reports: "I started as assistant professor at the Colorado School of Mines in Golden, Colo., this past fall." . . . **Edward Pena Perez**, a Course X graduate student, has received a Ford Foundation Predoctoral Fellowship as a minority scholar. The Fellowship, which provides funds for stipends and tuition for three years of tenure, seeks to increase the presence of underrepresented minorities on the nation's colleges and university faculties. Perez works in the field of bioengineering.

Glenn C. Williams, ScD '42, of Lexington, Mass., died on July 2, 1991. He was a professor emeritus of chemical engineering. Williams, who began teaching at MIT in 1940, was an authority on missile propulsion. He headed MIT's Torpedo Fuel Lab during World War II, work that was recognized with the Navy Ordnance Development Award, and later served as director of the MIT Fuels Research Lab. He was a former president of the Combustion Institute and in the late 1940s was an advisor to the Pentagon on military propulsion systems. In 1980 the Combustion Institute recognized him for "his distinguished, continuing, and encouraging contributions to the field of combustion" and presented him with the Sir Alfred C. Egerton Gold Medal. He held three patents and was the author of many articles. Williams co-authored a book, *Thermodynamics Charts for Combustion Processes*, with **H.C. Hottel**, SM '24, and **C.N. Satterfield**, SM '43, ScD '46, in 1949. He was deeply interested in graduate-level education and for many years was the graduate officer for Course X and a member of the Committee on Graduate School Policy. . . . The Alumni/ae Association has been notified that **John M.**

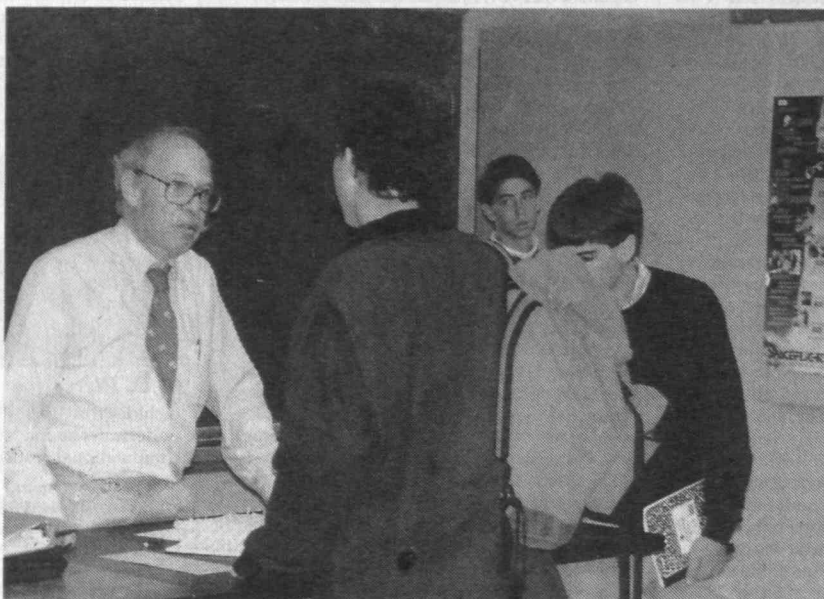
From Air Force Lab to High School Classroom

Shakespeare observed that one man in his time plays many parts. I never thought about the implications of that statement when I was earning a doctorate in Course VIII. But MIT was equipping me well for more than one part.

While working on a thesis under Professor George Harvey, I was a teaching assistant for 8.012 and 8.034, introductory physics subjects for transfer students. I really enjoyed teaching, but my main interest was research. So when I completed the degree, I joined the Air Force Laboratories in Bedford, Mass.

For nearly 30 years, I worked first in the physics of the extreme ultraviolet solar spectrum and its relation to the atmosphere, and later in rotating sensor problems, special relativity, and electromagnetism. It was a satisfying life: I did my research, published my papers, and had the fun (I choose the word carefully) of doing science.

On turning 60, I felt the need for change, and high school teaching made sense for me. There were many motivations, but three stand out. I find talking with people about physics a great pleasure, and teaching allows lots of that. Second, when only 30 percent of high school physics instructors have even a bachelor's degree in physics, our schools clearly need more well-trained science teachers. And perhaps most important to me, I thought that I could help address the dearth of women in science by making female students comfortable in physics class and encouraging them to go on in science. I hoped that being married to a woman with two MIT degrees (Selma Newburgh, MAR and MCP, '64) might give me some extra credibility when I admonished a promising 15-year-old that "I know you can do it."



Ronald Newburgh with some of his students at the Rivers School in Weston, Massachusetts.

Four years into my new career, I can say that my decision has been as rewarding as any in my professional life. For one thing, the students challenge me to find simpler, clearer ways to explain complex material, and it is exhilarating when I succeed. I had one particularly talented student—impressive on the playing field as well as in the classroom—who simply could not grasp the textbook treatment of "beats," the addition of waves of different frequencies. Her difficulties were not surprising, given the book's tedious and formal addition of two sine waves. When my own first attempt to explain beats fell equally flat, I got to thinking about the student's passion for sports. I realized that two runners on a circular track, running at different speeds, illustrate the concept. When one runner laps the other, they are again in phase, or "beating." That image made things clear for her and for many other students, and I recently published a short paper on the subject in *Physics Teacher* magazine.

I remember my first round of mid-year exams. My students did not do as well as I expected, and I felt that I had

failed them. A veteran of some 20 years' teaching reminded me that high school students have trouble with exams covering a large body of material. Her comments highlighted the fact that my exams had been written on the wrong standard. For years, my model for a totally engaging learning experience had been the summer Ben Borie, PhD '57, Otto Guentert, PhD '57, and I had studied together for the doctoral qualifying

exams. High school students are not yet ready to work that way. Reminded of that, I could adjust my teaching and testing to help them arrive at that point.

I am also making headway in my goal of encouraging women students. One member of my class at Worcester Academy, where I taught from 1987 to 1990, was Susan Wong, a quiet young woman of fierce intelligence. After her first two weeks at Worcester, she transferred from honors physics into my second-year advanced placement course. I saw that in spite of her hesitation, she was MIT material. My wife joined me in urging her to apply, and we arranged for her to talk to Katherine Chvany, who teaches Russian at MIT. Susan is now in her second year at the Institute.

I find I really enjoy the wide range of ages and experience among my teaching colleagues. In the creation of a new laboratory, the first people hired tend to cluster around a particular age. This cluster moves like a pulse through the years, as the laboratory grows older. Not so a school. At the Rivers School in Weston, Mass., where I teach now, one member of the Science Department is a new Middlebury College graduate and another is in his mid-thirties, having spent several years in the Peace Corps and at a Navaho reservation school. We all learn from each other. □

Chambers, SM '39, of McLean, Va., died on September 20, 1990. There was no further information provided.

XI URBAN STUDIES AND PLANNING

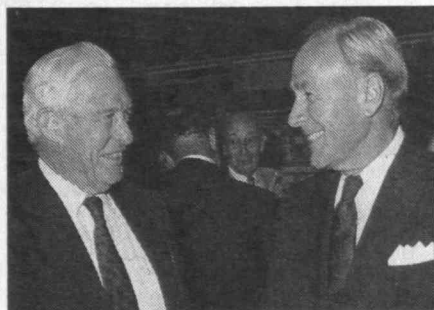
Francis T. Ventre, PhD '73, sends word from Silver Spring, Md.: "I had a stroke in February 1990 and have since retired from Virginia Tech (where I taught urban studies & architecture). I go to speech and occupational therapy three times a week and twice a week I go swimming. (It is a funny thing as I was swimming when I got the stroke....!!)" ... **Gail L. Kendall, MCP '79**, writes: "I moved to Albany, N.Y., from Cambridge and I love it! I am business manager for the Albany Institute of History & Art for half of the week and a consultant for the balance. My daughter is now 4 and with any luck she will have had twin brothers by Thanksgiving." ... **Diana M. Daniels, MCP '74**, VP and general counsel at the Washington Post Company, has been elected secretary of the Washington Post Company's board of directors. ... **Mary Christine Boyer-Karalis, MCP '69, PhD '72**, has been appointed professor of architecture with tenure at Princeton University effective September 1991. Most recently she was a professor and chair of the City and Regional Planning Program at the Pratt Institute's School of Architecture. An expert on urban architecture, Boyer has published three books: *Dreaming the Rational City: The Myth of American City Planning* (1983), *Manhattan Manners: Architecture and Style 1985-1900* (1985), and *The City of Collective Memory: Its Historical Imagery and Architectural Entertainments* (1991).

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

John Clark Johnson, SM '46 (XIV), ScD '48, of Worcester, Mass., died on June 15, 1991. He was a physics professor at Worcester Polytechnic Institute for 26 years until his retirement in 1980. During World War II, he served as a pilot of a P-38 fighter on weather reconnaissance flights over Italy. He spent six months in a German prison camp and was discharged from the Army Air Corps as a lieutenant colonel. Before joining the WPI faculty, Johnson was a research associate and physics lecturer at Tufts University.

XIII OCEAN ENGINEERING

Charles R. Cushing, '60, president of Charles R. Cushing Inc., New York City, has been named a Fellow of the ASME. ... **John J. McMullen, SM '45**, and **Frank J. Graziano, SM '45**, got together at Webb Institute of Naval Architecture in June.



J.J. McMullen F.J. Graziano

McMullen delivered the Commencement address while Graziano is chair emeritus of Webb's Board of Trustees.

Rear Admiral **Edward M. Peebles, SM '61**, NE

'61, of Reston, Va., died on June 24, 1991. He spent the majority of his career serving aboard submarines and working with technology that resulted in the construction of the U.S. nuclear fleet. He received the Legion of Merit in 1983. He was a member of the ASNE. Peebles retired from active duty as deputy commander of the Naval Sea Systems Command in 1983. He then taught physics at Bishop O'Connell High School in Arlington, Va., until retiring in 1989 for health reasons. From 1987 to 1989, he served as Chesapeake section treasurer of the American Association of Physics Teachers.

XIV ECONOMICS

David S. McClain, PhD '74, writes: "I was recently appointed the Henry A. Walker, Jr., Distinguished Professor of Business Enterprise and Financial Economics in the College of Business Administration at the University of Hawaii. I departed from Boston University's School of Management, where most recently I headed the Management Development Program-Japan from 1988-90." ... **Jacques Cremer, SM '73 (XV)**, PhD '77, sends word: "After being affiliated with VPI for eight very pleasant years, we have decided to try Toulouse, France. I will be affiliated with a newly famed 'Institut d'Economie Industrielle' at the Université des Sciences Sociales de Toulouse." ... **Richard L. Schmalensee, '65, PhD '70**, who was on leave to work on President Bush's Council of Economic Advisors, returned this past September to resume his post as professor of economics and management at the Sloan School of Management. ... **Thomas Romer, '68**, has been appointed a professor with tenure of politics and public affairs at Princeton University. Romer had been at Carnegie-Mellon University where he was appointed professor in 1983. In 1979-80 he was a visiting economist at the Federal Trade Commission. A political economist and an authority on the regulatory process, he is the author or coauthor of 30 publications.

Douglas Bernheim, PhD '82, also at Princeton, who joined the faculty in July 1990, has been appointed the John L. Weinberg Professor of Economics and Business Policy. A microeconomic theorist, he left Northwestern to join the Princeton faculty. In 1991 he published *The Vanishing Nest Egg: Reflections on Saving in America*. ... **Glenn C. Loury, ScD '76**, has traded his tenured professorship at Harvard's John F. Kennedy School of Government for one with Boston University's economics department. After nine years Loury decided that he wanted to return to his preferred area of study, economic theory. While at the Kennedy School, his focus was almost solely on economics as it related to social problems and public policy. ... Alan S. Blinder has published *Growing Together: An Alternative Economic Strategy for the 1990s* (Whittle Direct Communications, 1991). Blinder is the Gordon S. Rentschler Memorial Professor of Economics at Princeton University.

XV MANAGEMENT

George Warren Patterson III, SM '56, writes: "I am now working on system engineering projects on PC workstations in Andover, Mass., with emphasis on A/E/C CADD systems." ... **Luca Battaglini, SM '89**, sends word from Rome, Italy: "I am still working in the research department of I.M.I. (Istituto Mobiliare Italiano). My current projects cover the design of new investment products, valuation of stock options, and the study of the fees applied to services offered to investors. I will change my assignment before 1992, taking a more operational job." ... **Avi Frydman, SM '81**,

reports: "The family has relocated to Baltimore with Digital Equipment. Mady and the six children are getting used to being 'southerners.' Anyone else in the D.C. area? It would be great to have an annual function here." ... **Diana Mackie, SM '70, SM '79**, writes: "I never thought I'd get involved in drugs and race tracks! This year I directed a project sponsored by The Jockey Club to develop a new drug testing systems and rules to identify possible performance-affecting drugs in race horses and hounds. Not your typical McKinsey client!" ... **Stephen D. Fisher, SM '70**, is VP for financial services at Handy & Harman in New York City. He had previously been director of corporate finance for the Xerox Corp. in Stamford, Conn.

Anthony Kelly, '50, is the 1991 recipient of the ASM International's Gold Medal. Kelly is vice-chancellor at the University of Surrey in Surrey, England. The award, established in 1943, recognizes "outstanding knowledge and great versatility in the application of science to the field of materials science and materials engineering, as well as exceptional ability in the diagnosis and solution of diversified materials problems." ...



Raymond E. Britt, Jr., SM '61, has been appointed president of the Lake Forest Graduate School of Management. He previously headed the Britt Group, Ltd., as a consultant to management on planning, organization, and operating issues. ... **James E. Clark, '76 (VI), SM '81**, VP for High Performance and Fault Tolerant Systems

R.E. Britt, Jr.

at AT&T Computer Systems in Morristown, N.J., is one of five recently named to the Boston-based Computer Museum's board of directors. ... **Alison B. Kutchins, '82 (XIV), SM '82**, has been awarded a 1991-92 White House Fellowship. Kutchins, a VP in the Investment Banking Division of Goldman, Sachs & Co., was selected as one of 16 Fellows out of 800 applicants in recognition of her leadership, professional and intellectual achievements, and dedication to her community. As a White House Fellow, Kutchins will serve a one-year assignment as a special assistant in the Office of Cabinet Affairs at the White House. She will also participate in an education program which will include meetings with government officials, scholars, diplomats, journalists, and leaders of business and industry. At Goldman, Sachs & Co., the technology and health care sectors were Kutchin's main focus. She began her investment banking career in New York, first as a generalist, and later specialized in the needs of high technology and emerging growth medical concerns.

John R.M. Gordon, PhD '66, former dean of the Business School at Queens University in Kingston, Ontario, has received the school's first MBA teaching award and he has also been appointed to the Alcan Chair in Management and Technology. As dean of the business school from 1978-1988, Gordon was involved in getting a number of programs off the ground, including the Executive Program, the Queen's Business Clubs, the Advisory Council, and the Associates Program. Gordon sees one of his early priorities as bridging the gap between technology and management, and encouraging collaborative projects between the university and industry and business. ... IBM has awarded **Randall Dean Groves, SM '90**, a Corporate Technical Award for his part in the development and implementation of the Reduced Instruction Set Computer System/6000 architecture. He shared the award of \$130,000 with two others. Groves is the area manager of Advanced

Product Development for IBM's Advanced Workstation Division in Austin, Tex. The division is responsible for developing all of IBM's UNIX-based workstations and software.

Sloan Fellows

W. Frank Blount, SM '71, is president of The New American Schools Development Corp. in Arlington, Va. Previously he was group executive for Communication Products at the AT&T in Basking Ridge, N.J. ... **Roger W. Hale**, SM '79, chair of the Louisville Gas & Electric Co., in Louisville, Ky., is a new member of the board of trustees at Centre College in Danville, Ky. ... **James T. Johnson**, SM '77, VP & general manager of the Boeing Co.'s Everett division, was profiled in *The Seattle Times* on June 17, 1991. In the article Johnson discusses the challenge he faces in keeping continuous quality improvement going while getting ready for production of the 777 twinjet, which will require about 10,000 more workers. It is his plan to accomplish this without jeopardizing efficiency in production of the 767 and 747 which are also assembled in the Everett plant.

The Alumni/ae Association has been notified of the deaths of **Richard Bell Hutchinson**, SM '42, of Roswell, Ga., on March 15, 1991, and **Walter Daniel Howell**, SM '41, on June 9, 1991. There was no further information provided.

Senior Executives

William T. O'Shea, '87, is now senior VP for NCR Network Products Group in Dayton, Ohio. Previously he was VP for product management & development at AT&T Data Systems Group in Morristown, N.J.

Management of Technology Program

Ken Miller, SM '83, is VP for Estimate Services at Zacks Investment Research in Chicago. ... **K-C Tran**, SM '86, has been promoted to managing director of Environmental & Radiation Instrumentation at Gamma-Metrics in San Diego, Calif. He was in Boston recently and stopped by the program office to visit. He was married two years ago to Judy Heinitz. ... **Kozo Arao**, SM '90, has been transferred to United Solar Systems Corp. in Troy, Mich. ... **Geoffrey Gill**, SM '89, has a new job with Arthur D. Little in Cambridge. He is now a consultant in Technology Management. ... **Akio Mitsufuji**, SM '89, was on his way to visit at the Fuji Photo plant in Greenville, S.C., when, due to an unexpected stopover, he found himself in the Boston area and stopped by the Executive Education offices to see Jennifer Mapes and Peter Gil. Akio's son, who is now in junior high school and taller than Akio, is on the school basketball team. His daughter travels to Tokyo every Sunday to pursue ballet training at a studio there. His wife, Kyoko, teaches English at the Sahi Culture Center and the YMCA. ... **Wenlan Hu**, SM '91, is a consultant with Management Strategies in Boston.

Joe Pine, SM '91, had an expanded version of his thesis, *Paradigm Shift: From Mass Production to Mass Customization*, published by Harvard Business School Press this past September. He is now a programming consultant on the Worldwide Development staff at IBM in Purchase, N.Y. ... **Soo Wong**, SM '91, is engaged to Sloan PhD candidate Hauke Kite-Powell, whom she met in Jim Utterback's (PhD '69) fall class entitled "Management of Technology." They have set a wedding date of May 31, 1992. ...

Dave Wright, SM '91, is now a staff engineer with Delco Electronics Corp. He and Kip Stevely, SM '91, are planning to give a talk to the current MOT class this fall. ... **Steve J. Siegel**, SM '91, is engaged to Leslie Oaklander. They are planning a wedding for May of 1992. ... **Danny J. Doiron**, SM '91 is engaged to Heather Fifield and they are

planned a September 7, 1991, wedding date as of this writing. ... **Todd M. Moore**, SM '91, married Leighann on June 22, 1991. The ceremony took place in upstate N.Y. near Kingston. ... **Julie M. Fernane**, SM '91, and Stephen A. Joyce, PhD '87 (V), were planning an October 12, 1991, wedding at this writing. ... **Tom M. Heller**, SM '91, is engaged to Ann Czerwinka and they plan a May 23, 1992 wedding.

XVI AERONAUTICS AND ASTRONAUTICS

John Kenneth Haviland, PhD '61, sends word from Earlysville, Va.: "I retired from the University of Virginia's Department of Mechanical and Aerospace Engineering as professor emeritus on June 1, 1969." ... **Martin C. Jischke**, SM '64, PhD '68, has been selected as the 13th president of Iowa State University. During his five-year tenure as chancellor of the University of Missouri at Rolla, enrollment decline was reversed, sponsored research was increased by 50 percent, the number of private donors doubled, and a major program of manufacturing research and technology transfer was initiated. Jischke also spent 17 years at the University of Oklahoma at Norman, serving as dean of the College of Engineering from 1981-1986, interim president in 1985, and director and professor of the School of Aerospace, Mechanical, and Nuclear Engineering from 1977-1981. From 1975-1976, he was a White House Fellow and special assistant to the Secretary of Transportation in the U.S. Department of Transportation. A trained fluid dynamicist, Jischke is an expert in heat transfer, fluid mechanics, aerodynamics, and problems related to high-speed aircraft and spacecraft. **Donald Spangenberg**, SM '55, of Lansdale, Pa., died on June 21, 1991. He had worked as an engineer at the Johnsville Naval Air Development Center in Philadelphia for 35 years. He was a U.S. Army Reserves veteran of the Korean War. Spangenberg served as a short-term missionary in the African Inland Mission in Kenya, to which he traveled several times.

XX APPLIED BIOLOGICAL SCIENCES

Joseph John Licciardello, PhD '60, of Reading, Mass., died on June 22, 1991. He was a research supervisor at the National Oceanic and Atmospheric Administration in Gloucester, Mass., for 16 years. He served on the International Atomic Energy Agency Committees and was author and co-author of many publications relating to microbiology, food science, and technology. Licciardello was in the Army Air Corps during World War II, serving in the European and North African theaters, and was awarded the distinguished flying cross as well as several other commendations.

XXI HUMANITIES

Paul G. Chapin, PhD '67, sends word from Washington, D.C.: "I have received the National Science Foundation Director's Award for Program Officer Excellence. This is the first time this award has been given. I am Program Director for Linguistics as NSF."

XXII NUCLEAR ENGINEERING

Colonel **Michael H. Fellows**, SM '74, PhD '86, writes: "My current Army assignment is as chief of the Environmental Restoration Division for the

U.S. Army Corps of Engineers in Washington, D.C."

TPP TECHNOLOGY AND POLICY PROGRAM

Seth Hulkower, SM '86, and Lisa Perlman were married on June 16, 1991. **Chris Barnett**, '77 (II), SM '80, **Mark McCabe**, SM '86, and **John Wasson**, SM '86, attended the celebration. ... **Carolyn Wong**, SM '87, is joining a PhD program at UCLA in political science on a four-year fellowship. ... **Sylvia Marin-von Koller**, SM '88, recipient of the 1988 TPP Best Thesis Award, is now working as assistant regional coordinator in San Jose, Costa Rica, for PACA, which is funded by CARE, the Nature Conservancy, and Conservation International. ... **Madhu Nott**, SM '91, is currently working at Arthur D. Little in Cambridge. ... **Aaron Curtis**, SM '90, SM '91 (XV & TPP), has joined the staff of Boeing Renton Plant in Seattle, Wash., as a safety systems engineer.—**Rene Smith** for Richard de Neufville '60, Technology & Policy Program, MIT, Rm. E40-252, Cambridge, MA 02139.

STS PROGRAM IN SCIENCE, TECHNOLOGY & SOCIETY

Please send your news to Phyllis Klein, STS Program, MIT, E51-128, Cambridge, MA 02139.

PUZZLE CORNER

Continued from page MIT 55

The tens column cannot produce a carry, because the total for that column would have to be 19, forcing both O and W to be 9. Therefore, from the hundreds column, $9 + O = 10 + P$, and $P + 1 = O$.

Y, P, and O are consecutive ascending digits. Therefore, Y must be between 1 and 6 inclusive. It is relatively easy to try all possibilities. O + W must equal 8 or 9, and which it equals dictates whether or not W + N must generate a carry. B must be at least 9 - E to generate a carry for Y. R is the catch-all letter; any digit will work, so it gets what's left. Murphy prevailed, as I started with Y = 1 and the correct value is 6. The code is:

0 = U	1 = W	2 = R	3 = N	4 = E
5 = B	6 = Y	7 = P	8 = O	9 = L

649981 + 52813 = 702794

Better Late Than Never

Jan 2. Nob. Yoshigahara notes that a Japanese reader of his column solved this large cryptarithmic division problem by hand, working for 11 hours, a mighty feat. Recall that last issue we reported that a 386SX solved it in 49 hours.

Apr 2. Mary Lindenberg notes that we misprinted her definition of C₅; the correct definition is "the number of nuts each thief gets in the morning".

Other Responders

Responses have also been received from I. Shalom, M. Auerbach, A. Ornstein, M. Gilman, S. Feldman, N. Spenser, H. Garber, Y. Zussman, J. Grossman, J. Chandler, T. LeCompte, S. Barr, F. Furland, H. Garber, R. High, K. Rosato, A. Cangahuala, C. Whittle, E. Dawson, G. Rice, R. Shapiro, J. Mohr, N. Yoshigahara, and A. Silva.

Proposer's Solution to Speed Problem

"Letters of the Alphabet," "Wonders of the Ancient World," "Arabian Nights," "Signs of the Zodiac," "Cards in a Deck (with the Jokers)."

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

Arthur R. Brooks, '17; July 17, 1991; Summit, N.J.
Harold E. Langley, '19; August 6, 1991; Durham, N.H.
Alan G. Richards, '19; January 25, 1991; Arcadia, Calif.
Edward E. Saunders, '19; April 23, 1991; McLean, Va.
William F. Dewey, '20; August 11, 1991; Seminole, Fla.
Eric L. Etherington, '20; August 1, 1991; Los Angeles, Calif.
Andrew Jackson Fassitt, Jr., '20; June 8, 1991; Natick, Mass.
Roy J. Campbell, '21; June 26, 1991; Bath, Maine.
Edward W. Haywood, '21; August 9, 1991; Braintree, Mass.
Mortimer C. Bloom, '22; February 2, 1990; Langdown Bath, England.
Horatio L. Bond, '23; July 27, 1991; Hyannisport, Mass.
Benjamin Cooper, '23; February 22, 1991; Westport, Conn.
George William Gilman, '23; June 2, 1991; Rockport, Mass.
Arthur Lefevre Hill, '23; April 28, 1991; San Diego, Calif.
Bertram Eugene Warren, '23; June 27, 1991; Arlington, Mass.
Lester C. Twichell, '24; June 8, 1991; Villa Park, Calif.
Edward H. deConingh, '25; May 4, 1991; Shaker Heights, Ohio.
Paul Revere Goldings, '25; December 12, 1990; Brooklyn, N.Y.
Howard R. Parker, '26; August 3, 1991; Boxborough, Mass.
Richard W. Sherman, '26; June 5, 1991.
Endre Sziklas, '26; July 9, 1991; Richmond, Va.
Irving L. Hopkins, '27; June 12, 1991; Mount Pleasant, S.C.
Charles Frederick Sweet, '27; October 21, 1990; Gettysburg, Pa.
Kenneth Grosset Bucklin, '30; May 7, 1991; Ormond Beach, Fla.
Madeleine B. Campbell, '30; August 1, 1991.
John DeLorenzo, '30; June 27, 1991; Duxbury, Mass.
William Oliver Christy, '31; March 11, 1991; Midlothian, Va.
Russell W. Hoch, '31; July 28, 1991.
Robert C. Kennedy, '32; April 23, 1991; Niagara Falls, N.Y.
Joseph B. Smith, '32; November 22, 1990; Salem, Mass.
Abner C. Hopkins, Jr., '33; February 22, 1991; Fort Meyers, Fla.
Ralph Peterson, '33; November 11, 1990; Tucson, Ariz.
Allen Burpee Folger, '34; June 8, 1991; Wollaston, Mass.
Albert F. Hayes, '34; July 18, 1991; Derry, N.H.
Jacob Arthur Pekin, '34; May 31, 1991; Marblehead, Mass.
Lewis Mendelsohn, '35; June 4, 1991; Swampscott, Mass.
Bernard Whitman, '35; June 26, 1991; Marshfield, Mass.
George J. Bair, '36; July 31, 1991; West Palm Beach, Fla.
Marcus F. Warmuth, '36; August 24, 1990; Wyckoff, N.J.
Thomas F. Hennessy, '37; May 14, 1991; Palm Beach Gardens, Fla.
John Buxton Pitkin, '37; February 15, 1991; San Luis Obispo, Calif.
Edward L. Vollmer, '37; January 18, 1990; St. Louis, Mo.
Cornelius V.S. Roosevelt, '38; August 3, 1991; Washington, D.C.
Warren Emerson Thomson, '38; June 22, 1991;

Edgewood, Md.

John M. Chambers, '39; September 20, 1990; McLean, Va.
Gilbert Earl Hoffman, '39; May 14, 1981; Keystone Heights, Fla.
Robert B. Egbert, '40; July 10, 1991; Albuquerque, N.Mex.
John M. Kirk, '40; July 1, 1991; Rockport, Mass.
Walter Daniel Howell, '41; June 9, 1991.
Walter Kinney, Jr., '41; July 16, 1989; San Pedro, Calif.
William F. Petrovic, '41; June 25, 1991; Bremertown, Wash.
Kenneth Tsunoda, '41; June 20, 1991; Clackamas, Ore.
Fred L. Chase, '42; July 28, 1991; Arlington, Mass.
Richard Bell Hutchinson, '42; March 15, 1991; Roswell, Ga.
Glenn C. Williams, '42; July 2, 1991; Lexington, Mass.
Frederick G. Perry, Jr., '43; July 25, 1991; Jackson, N.H.
Ralph Allen Barrows, '44; June 27, 1991; Pocasset, Mass.
Milton Yusem, '44; April 28, 1991; Oak Park, Ill.
Alfred Edwards, '46; July 7, 1991; Franklin, Mass.
John Clark Johnson, '46; June 15, 1991; Worcester, Mass.
Ralph W. Rawson, '46; August 3, 1991; Madeira Beach, Fla.
Alban S. Eavenson, '47; June 8, 1991; Visalia, Calif.
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Irving Abrams
Saul J. Copelman
Robert F. Cummings
Fred C. Hall
David H. Harris
Edwin H. Koehler
Edward J. O'Connor
James B. Spratley
Eugene V. B. Van Pelt, Jr.
Morton P. Woodward

1923
Horatio L. Bond
August A. Buhler
Charles T. Burke
Howard A. Lockhart
J. Henry Scholtz
Philip H. Vivian

1924
Walter J. Bagby
Domingo J. Bellingeri
Homer S. Davis
Gardner B. MacPherson
Anthony D. Matarese
William Rosenwald

1925
Gates W. Burrows
Alan W. Crowell
L. Patterson Elliott
Yu H. Ku
Arthur M. Sharp
Anthony G. Tsongas

1926
George A. Booth
George Cohen
Robert W. Conly
William W. Farr
Alec Fisher
Mrs. John A. Gibson
Thomas D. Green
Reverdy Johnson
Joseph L. Levis
Albert P. Libbey
Benjamin Margolin
Charles P. McHugh
M. Bernard Morgan
Henry A. Sargent
Marvin S. Smith
Louis R. Taylor
Joel S. Tompkins

1927
Harold J. Creedon
Carlton G. Davies

E. Robert de Luccia
Charles Kingsley, Jr.
Gustavo Lobo Jr.
George E. Onishi
Paul E. Parker
Herbert Parkinson
Jack B. Peters
Harland P. Sisk
Robert M. Tucker
Frederick W. Willcutt

1928
George I. Chatfield
Mrs. Victor J. Decorte
Arthur R. Elliott
Newton S. Foster
Lawrence Glassman
Albert J. Gracia
William M. Hall
John J. Hartz
Arthur C. Josephs
Morris H. Klegerman
Ernest H. Knight
Paul J. Martini
Walter F. H. Matlage
John C. Melcher
John T. Metcalf
Albert J. Puschin
John K. Rouleau
Carroll C. Smith
Abraham G. Stone
James E. Ure

1929
Eric A. Bianchi
Newton W. Bryant
Arnold W. Conti
William E. Creedon
Hyman J. Fine
Renato D. Fracassi
Alfred H. Hayes
John G. Howell, Jr.
Joquin J. Llanos
Jonathan F. McCray
Almer F. Moore
Neil C. Ross
Hunter Rouse
Arthur F. Turner
J. Wesley Walters
David H. Wilson
Carlton E. Wood

1930
Lawrence B. Anderson
Josiah S. Barrett
John F. Bennett
Elmer R. Burling
B. Alfred Carideo
Homer L. Davis, Jr.
Leslie W. Engler
Leonard H. Goodhue, Jr.
Philetus H. Holt
Allan J. McLennan
Irvine E. Ross, Jr.
Anthony R. Savina
John J. Scheuren, Jr.
Wayne A. Soverns
Olin J. Stephens II
Ernest J. Tauch
Alan W. Vint

1931
Herbert K. Allbright
Henry E. Baratta
C. Randolph Binner
Edmund G. Blake
Wyman P. Boynton
Charles Broder
Frank E. Dame
Harold J. Davis
John H. Dodge
Edwin J. Ducayet
Arthur G. Fuller
Laurence C. Hicks
Albert L. Kaye
George Moy
William A. Pitbladdo
Henry D. Randall, Jr.
Mrs. Frederick A. Ritchie

F. David Schweizer
Angel Silva II
H. Sheldon Smith
William A. Stellrecht
John R. Swanton, Jr.
Henry B. Walker
Kenneth E. Wischmeyer

1932
William F. Bannon
Robert T. Billings
Edward F. Cahoon
Melvin Castleman
Sidney M. Edelstein
John W. Flatley
Joseph L. Friedman
G. Robert Klein
Eugene F. Lynch
Charles E. McCormack
Edmund F. McLaughlin
Jacob Millman
Willis M. Moore, Jr.
Robert K. Knight
James G. Ritchey
Thomas R. Smith
Charles H. Taylor
Herbert M. Wagner
John Zouck

1933
Morris C. Beldon
George R. Churchill
Warren S. Daniels
Robert A. Dobson
Arthur S. Hayden
Robert Heggie
Paul J. Pettimermet
Frank A. Record
Stephen H. Rhodes
Richard Robinson
I. Harry Summer
Warren G. Webster

1934
Cassius C. Belden
John G. Borger
Leo A. Carten
Roger T. Coffey
Kenneth L. Dorman
Lawrence C. Ebel
Joseph Fishman
George Irvin Gahm
George C. Hatch
Walton W. Hofmann
H. Neal Karr
Theodore O. J. Kresser
E. Philip Kron
Ernest E. Lockhart
Douglas C. MacMillan
John J. McHugh, Jr.
Jerry B. Minter II
Walter F. Read
Theodore N. Rimbach
Charles E. Sanders
Herbert R. Schwarz
Melvin A. Sousa
Frederick Spaney, Jr.
Malcolm S. Stevens
Bernard N. Stiller
Warren L. Towle
Philip B. Walker, Jr.
Max Winer
Walter L. Wise, Jr.

1935
John B. Ballard
J. Goffe Benson
Willard F. Bixby
Lester A. Brooks
David J. Buckwalter
James E. Castle
Mrs. William W. Cross
Thonet C. Dauphine
Leo H. Dee
George C. Dunlap
Richard H. Eshbaugh
Gerhard T. Feyling
Ellis M. Flink
Robert F. Flood

Paul L. Gilmont
Joseph L. Haggerty
Frank R. Hatch
Richard L. Hughes
John M. Kohr
Stanley M. Lane
Jacob Leeder
Franklin F. Lovering
Robert C. Madden
Avedis D. Marderosian
Rollin D. Morse
John A. Rodgers
Robert W. Spinney
Frank S. Walters
Chandler Wentworth
Kasmierz J. Winiarski
Edward Woll

1936
Aldo H. Bagnulo
James G. Baker
W. Boynton Beckwith
Leonard B. Chandler
Edward E. Christopher
William A. Cresswell, Jr.
George F. Crumney
Kathleen V. Cummins
Vincent T. Estabrook
Lewis Gelbert
Carl A. Gelpke
Eli A. Grossman
Anton E. Hittl
Aurelius P. Hornor, Jr.
Stanley T. Johnson
Morris Lepes
Mrs. Robert Leventhal
Walter K. Mac Adam
August V. Mackro
Brockway McMillan
Harold F. Miller
John A. Myers
Roman L. Ortynsky
James F. Patterson
Frank L. Phillips
Winthrop G. Scott
Dorian Shainin
Robert H. Walker, Sr.

1937
Roger C. Albiston
Frederick J. Altman
William O. Arnold
Henry Blackstone
Robert C. Glancy, Jr.
John M. Gould
Archibald R. Graustein, Jr.
Thomas L. Hallenbeck
Daniel J. Hanlon, Jr.
Josiah S. Heal
Charles F. Healey
Mrs. Sydney B. Karofsky
Francis X. Maida
Leon A. Menzl
John B. Nugent
Thomas A. O'Brien
Philip H. Peters
Melvin A. Prohl
Harold E. Prouty
John C. Robbins, Jr.
Norman B. Robbins
Joseph A. Smedile
Robert H. Thorson
Edward F. Tibbetts
James Warburton
Ralph P. Webster, Jr.
Albert E. Whitcomb
Duane O. Wood
G. Richard Young

1938
Lewis H. Allen, Jr.
Franklin S. Atwater
Howard Banzett
Donald R. E. Barnaby
Russell H. Brown
Harold W. Butler
Jeanne K. Buxbaum
Dempster Christenson
Albert M. Clogston

Russell C. Coile
Adam C. Gambel
Robert S. Gordon
Gifford Griffin
Horace H. Homer
Roy C. Hoppood
Harold James
Sumner H. Kalin
Frank B. Kemp
H. Bruce Leslie
Donald S. MacDonald
Bernard W. Mehren
Anne S. Mowat
Enver Muradoglu
James P. Pollock
Harry O. Saunders
Donald P. Severance
Harold H. Strauss

1939
John F. Allen
Antonio Arias, Jr.
G. William Beer
George Beesley
Louis S. Castleman
R. Wade Caywood
Harold Chestnut
John H. Crankshaw
C. Philip Epifano
Gus M. Griffin
Ralph L. Hegner
Ernest R. Kaswell
David G. Kaufman
Burkhardt A. Kleinhofer
David N. Lindberg
Lawrence M. Lyons
David E. Morgan
G. Arthur Morrell, Jr.
Frederick S. Nowlan, Jr.
W. Hewitt Phillips
George G. Poulsen
Robert W. Pratt
Paul E. Sandorff
Carl A. Segerstrom, Jr.
Samuel Sempier
Edwin K. Smith, Jr.
Rodolfo M. Soria
Julian M. Spencer
Alexander Squire
Winthrop M. Steele
Robert V. Sternberg
Robert A. Stone
Alexander M. Thackara
G. Woodford Thomas
Wallace P. Warner
Theodore A. Welton

1940
Edgar W. Adams, Jr.
Lawrence A. Benenson
Edgar L. Bernard
Daniel Blitz
Benjamin A. Boshier
Scott Brodie
Harvey H. Brown
Roy W. Brown
Samuel P. Card
Knight S. Carson
Robert J. Davis
Charles Forbes DeMailly
George A. d'Hemecourt, Jr.
Margaret T. Dienes
Richard J. Eberle
Harry A. Ferullo
Morris I. Gabel
Philip M. Garratt
Richard E. Gladstone
Harold Graham
William H. Hagenbuch
Edward G. Hellier
John Kapinos
Daniel S. Karp
Wylie C. Kirkpatrick
Joseph K. Knight
J. Halcombe Laning
Joseph F. Libsch
David F. Lowry
Richard E. MacPhaul
Marshall D. McCuen

John P. McEvoy
Richard F. McKay
William W. Merrill
Ralph T. Millet
Richard M. Powers
Judson C. Rhode
Adolph L. Sebrell
Philip A. Stoddard
Ralph N. Thompson
M. Spalding Toon
John A. Vanderpoel
David K. Wang
Jackson E. Wignot
George M. Wolfe

1941
Stanley Backer
Robert E. Bailey
Albert L. Bensusan
George B. Boettner
Kenneth A. Bohr
Paul E. Carlson
Ralph B. De Lano
Robert J. Demartini
Mason L. Downing
Robert S. Edwards
Leo E. Farr, Jr.
Theodore V. Ferris
Philip B. Freeman
Lewis D. Fyke
Richard Herman Gould
Frederick Haddock, Jr.
C. William Hargens III
Chester N. Hasert
Franklin Hawkins
Rudolph W. Hensel
Karl W. Hering
David W. Howard
Paul J. Joyce
Gardner M. Ketchum
I. Warner Knight
John W. Kraus
William E. Lifson
John F. Lyons, Jr.
Martin Mann
Mitchell J. Marcus
Stanley Marple, Jr.
Robert W. Mayer
Howard A. Morrison, Jr.
Willard S. Mott
Mrs. Raymond G. O'Connell
Edward K. Owen
John Peceovich
Lloyd J. Perper
Harvey I. Pofcher
Joseph S. Quill
Harold Radcliffe
Albert H. Riehl
J. Paul Sanderson
Robert L. Sinsheimer
John J. Symons
Payson S. Tseu
Rodrigo Uribe
John F. Wallace
Leona N. Zarsky

1942
Roswell W. Austin
Arthur W. Avent
Lawrence E. Beckley
William A. Bolhofer
Henry S. Brightman
Gordon P. Brown
David Christison
Robert H. Crosby, Jr.
Luther Davis, Jr.
Walter S. Eberhard
Philip E. Fox
Robert H. Given
A. Paul Hotte
A. Carleton Jealous
Carthrae M. Laffoon
S. Dean Lewis
Warren S. Loud
Ferdinand Lustwerk
Alan B. Macnee
Charles D. Magdick
Adrian G. Marcuse
Claude M. McCord, Jr.

Joseph R. McHugh
David B. Nicholson
Milton M. Platt
William A. Rote
Robert N. Secord
Morris A. Steinberg
Louis E. Stouse, Jr.
Maurice E. Taylor
Edward P. Todd
Peter G. Volanakis
Carl Zeitz

1943
Arthur C. Angelos
George W. Bartlett
Arthur O. Black, Jr.
Howard M. Bollinger, Jr.
Frank E. Briber, Jr.
Charles F. Chubb, Jr.
Paul R. Coulson
Frank B. Dibble
Charles A. Duboc
David M. Falk
Richard M. Feingold
Ralph R. Feuerring
Leo A. Fitzpatrick
William G. Franklin
James F. Hoey, Jr.
James H. Johnson
Wilfred Kanab
Robert S. Kelso
Hung Liang
John G. Linvill
T. Kemp Maples
John M. Miller
Thomas A. Mitchell, Jr.
Robert S. Reebie
Don H. Ross
William L. Sammons
William A. Selke
Myron A. Shoffner
Sidney Siegel
F. Curtis Smith
Morton F. Spears
John C. Stetson
Herbert G. Twaddle
William A. Verrochi
Hans G. Walz
Thomas W. Winstead
Michael Witunski

1944
Edgar C. Ahlberg
James B. Angell
Martin Annis
Ralph A. Barrows
Norman Beecher
Robert E. Benedict
Manfred A. Biondi
Warren A. Bishop
Henry C. Bourne, Jr.
Henry N. Bowes
John H. Burdakin
Thomas W. Carmody
F. Scott Carpenter, Jr.
Herbert L. Carpenter, Jr.
John Chamberlain
Andrew Chaplin
Frank K. Chin
Andrew F. Corry
E. H. Cumpston
Louis R. Demarkles
Gonzalo C. Docal
R. Dean Dragsdorf
Bernard J. Duffy, Jr.
John E. Egbert
Paul F. Ely, Jr.
John G. Floden
Roger M. Freeman, Jr.
Weston W. Goodnow
Herman J. Harjes
Holton E. Harris
Robert V. Horrigan
Warren H. Howard
Austin T. Hunt, Jr.
William A. Jack
Walter A. Jaeger
Martin King
Jay M. Kogan

Gilbert K. Krulce
Lorenzo A. Lamadrid
Samuel H. Lamport
Francis N. Le Baron
Han Tang Liu
Robert D. Maher
Robert Oppenlander
Edmund W. Peakes
E. Alfred Picardi
C. Spencer Powell
William S. Richardson
Paul M. Robinson, Jr.
George S. Saulnier
Caspar C. Schneider, Jr.
William B. Scott
Leland F. Stanley
John E. Stevens
Robert V. Thiede
Page S. Ufford, Jr.
Robert H. Wood
John Woolston
William A. Wynot
Aaron Zicherman

1945
John O. Atwood
James M. Barrabee
Walter E. Borden III
George R. Brothers, Jr.
Richard L. Cannaday
Carlos A. Dasso
David P. Flood
L. Robert Gardner
Guy W. Gilleland, Jr.
Reynold A. Grammer, Jr.
Charles H. Hart III
William L. Hatton
Mrs. James B. Hoaglund
Sing Leong
Robert N. Maglathlin
Andrew A. Marocchi
William G. Martin, Jr.
Arthur E. Miller
Nicholas V. S. Mumford, Jr.
William H. Pasfield
David O. Richards
Eugene S. Rubin
Max E. Ruehrmund, Jr.
Robert K. Schumacher
Clinton H. Springer
Edward Stoltz, Jr.
John M. Thompson
Daniel R. Vershbow

1946
Richard M. Adler
Louis B. Barber
Edward L. Belcher
Raymond E. Benenson
L. G. Body
Sterling S. Bushnell
William J. Casey III
Daniel I. Cooper
Hillman Dickinson
Thomas J. Donnelly
Stanley T. Droski
John S. Filbert, Jr.
James A. Finney, Jr.
A. E. Halberstadt, Jr.
Sigurdur G. Halldorsson
Ernest G. Jaworski
Mason I. Lappin
John B. Littlefield
Alexander W. McEwan
James S. Murphy
William H. Peake
James C. Ray
Gifford H. Stanton
Richard J. Steele
John W. Taylor, Jr.
Edwin H. Tebbetts
Juan B. Vicini
Montague R. Ward, Jr.
Robert E. Wentsch

1947
John E. Bartelt
Thomas H. Bay
S. Lewis Bernheim

Peter Callejas
William J. Crawford III
Steffen F. Dieckmann
Walter R. Ericsson
Rufus M. Franklin
David H. Frantz, Jr.
Wilfred L. Freyberger
John G. Holmes
Charles W. Hoover, Jr.
Arnold S. Judson
Walter P. Kern
Herbert J. Laskin
Robert A. Lombard
John C. Martin
John J. Murphy
Aaron Newman
Gilbert S. Parker
Alexis Pastuhov
Peter P. Poulos
Joseph J. Riley
Richard A. Scheuing
Paul K. Schilling
Arthur Schwartz
Irving L. Schwarz
Carol Tucker Seward
Harry Sherman, Jr.
William R. Smith-Vaniz
Marvin W. Sweeney, Jr.
Robert D. Thirkield
Ferdinand S. Veith
Harlow H. White
Howard A. Zwemer

1948
Stanley Abkowitz
S. James Adelstein
Eugene Ashley
Fred C. Bailey
Marshall E. Baker
William Bangser, Jr.
Jack Baring
Richard V. Baum
S. Martin Billett
Carl Blake
Barry M. Bloom
Joseph J. Bongiovanni
Paul A. Buckingham
Thomas J. Cahill
Leo Celniker
Cassius M. Clay
George F. Clifford
Richard J. Conlan, Jr.
Bernard P. Devins
Nicholas De Wolf
George S. Dundon
Guido J. Frassinelli
John L. French
Robert S. Friedman
Alden F. Greenlaw
Peter A. Guercio
Elton F. Hammond, Jr.
Geraldine M. Haughey
Edwin E. Hebb, Jr.
E. Neil Helmers
John C. Henderson
Robert O. Hirsch
F. W. Horstkotte, Jr.
William N. Hosley
Howard A. Jacobson
Jerome T. Jarrold
Donald Jenkins, Jr.
Robert H. Jenkins
Harry G. Jones
William J. Joyce
William E. Katz
Harry L. Kopp
Louis F. Kreek, Jr.
Philip M. Lally
Irwin L. Lebow
James Leon
Franklin E. Mange
James E. Manson
Raymond E. Maritz, Jr.
Bonni P. Martinez
Manuel L. Matnick
John C. Moore
Robert R. Mott
John E. Nicholson
Julian F. Pathe

Russell S. Paulnock
Donald M. Perkins
Gordon H. Pettengill
Thomas H. Pigford
Hernan Rocha Garza
J. Norman Rossen
Jay S. Salz
Robert L. Sandman
George E. Sherman
Robert H. Shoulberg
Arnold M. Singer
Earl K. Solenberger
Donato R. Telesca
Charles M. Tenney, Jr.
Harvey B. Willard
Backman Wong
Haig S. Yardumian
Norman S. Zimbel

1949
Angelo R. Arena
Robert A. Arrison, Jr.
Orlien N. Becker
Robert O. Bigelow
Frederick I. Brown, Jr.
Bruce Campbell
Norman A. Chrisman, Jr.
Laurence B. Collins
Gary S. Colton
Richard A. Cousins
Stanley S. Davies
Thomas J. Devine
John R. Doyle
H. Federhen IV
Guilford W. Forbes
William A. Forsyth, Jr.
Paul Gadebusch II
John W. Goppelt
A. Neale Gordon
Harold G. Green
Ronald L. Greene
Robert W. Grott
Dwight H. Hibbard
Arthur M. Howarth
Sidney C. Howell
Harold G. Ingraham, Jr.
David B. Kellom
Edward M. Kerwin, Jr.
Otto E. Kirchner, Jr.
John A. Knowlton, Jr.
Malcolm H. Kurth
Thomas J. Lamphier
Richard E. Lang
Ray E. Larson
Demetre P. Ligor
Raymond A. Lindstedt
George P. Loomis
Arthur C. Loven
William J. Lueckel, Jr.
John T. Lumis
Stanley V. Margolin
Gregor F. Meyer
Richard D. Morel
Oscar F. Noss, Jr.
Paul B. Ostergaard
Albert T. Owens
Chester M. Patterson, Jr.
Jan B. Peyrot
Andrew R. Pfeifferberger
Lewis H. Roosa
John R. Saxe
William C. Schneider
Richard J. Scully
Gordon D. Shingleton
Richard W. Spencer
Herbert L. Spivack
Bernard D. Steinberg
Edward T. Thompson
J. Thomas Toohy
Charles M. Walker
Eugene E. Woodward
Marvin D. Zimmerman

1950
David D. Adams
Augustus F. Andrews
Richard F. Armknecht, Jr.
Walter S. Attridge, Jr.
George A. Basta, Jr.

Alan G. Bates
Norton Belknap
Herbert D. Benington
Lowell S. Bensky
Ralph W. Booker
Sterling G. Brisbin
Thomas C. Buchanan
William L. Carey
Cosimo L. Cataldi
Edward S. Cohen
Nathan H. Cook
Edwin A. Corrie
John W. Craig, Jr.
Jack E. Downhill
Alyn W. Eade
Benjamin M. Eisenstadt
A. John Esserian
James M. Fitzpatrick, Jr.
Harry G. Foden
Edward L. Friedman
Alfred J. Gallucci
James W. Geiser
Sebastian J. Gianni
Thomas N. K. Godfrey
Robert F. Gordon
Frederic D. Grant
Malcolm Green
John A. Gutai, Jr.
Robert A. Haass
Donald A. Harnsberger
Emile F. Harp
Francis X. Hogan
Harry H. Houdyshell
James T. Jensen
Reginald A. Krystyniak
John S. Lane
John B. Lawson
Gerald A. Lessells
Andrew T. Ling
Paul A. Lobo
James M. Lydon
Stanley Martin, Jr.
Gordon I. McCain
Daniel L. McGuinness, Jr.
John T. Mc Kenna
Jonas Medney
Raymond M. Moeller
William E. Moore II
William E. Mooz
William Murphy, Jr.
Will F. Nicholson, Jr.
John J. Paull, Jr.
Paul F. Pearce
Philip K. Pearson, Jr.
Alvin D. Pendleton
William S. Peppler, Jr.
Alfred M. Petrofsky
Robert L. Plouffe
Richard R. Potts
Albert Rand
Milton L. Rand
Mariano A. Romaguera
Kenneth A. Sawyer
Henry C. Sharp, Jr.
Albert V. Shortell, Jr.
Robert P. Smith, Jr.
Richard A. Stephan
Edward R. Stover
Wendell G. Sykes
Robert W. Terry
Constantine T. Tsitsera
Anthony Vinciguerra
Mrs. John T. Weaver
Robert E. Wilson
Benjamin J. Wood
Louis Young

1951
Marshall E. Alper
Manfred E. Becker
John H. Bergmann
John Birmingham
Christian C. Bolta
William J. Cavanaugh
Arturo Chavez-Jofre
Donald K. Crockett
Rane L. Curl
Richard M. Davis
John F. Dennis

Karel den Tex
George L. Downie
Bradford W. Edgerton
Charles W. Ellis III
Allan Elston
Pablo Epstein
George B. Field
David Findlay
Merton C. Flemings
Marvin H. Frank
Herbert H. Gevirman
Harold S. Glenzel
Richard T. Greenhill
Avrom R. Handleman
Alan H. Hein
Parker W. Hirtle
Lawrence W. Hitchins
James R. Hodges
Rodney G. Huppi
Guy E. Inshaw
Henry R. Jex
Charles N. Johnson, Jr.
Erik Klokholm
Karl Kniel
Hubert E. Knipmeyer
J. Franklin Koehler
L. Keith Koehler
Robert W. Kress
William A. Krivsky
Nathan G. Lieberman
Robert A. Lindquist
Robert L. Lord
John C. Lowry
Gerald E. Lyons
Robert L. MacCallum, Jr.
Wilfred G. Mackey
Robert P. Madrulli
T. A. Mangelsdorf, Jr.
Stanley J. Marcewicz
Henry N. Marsh, Jr.
James K. McCauley
William R. Miller
Forest C. Monkman, Jr.
William F. Moon
John H. Morgenthaler
Alfred P. Olivera
Charles A. Orne, Jr.
James A. Pitcock
Lester W. Preston, Jr.
Richard H. Reuther
William G. Rhoads
Bernard Rothzied
Robert T. Ryland, Jr.
Roy M. Sachs
L. Kent Schwartzman
Frederick Segal
Harold Aryai Siegel
Lester M. Slocum, Jr.
David M. Sparling
Anthony Stathopoulos
G. R. St. Pierre, Jr.
Richard Strauss
Louis G. Sylvia, Jr.
Milton B. Trageser
Walter I. Wells
Herbert H. Woodson
I. Victor Yancey

1952
Arthur I. Auer
Charles G. Beaudette
John C. Berlinguet, Jr.
Stanley I. Buchin
Allan Chin
Bock M. Chin
Robert H. Damon
Robert W. Danforth
Milton S. Dietz
James Dorsey
Peter R. Ehrenberg
Daniel E. Finger
Alan S. Geisler
Herbert Glantz
Jack H. Guthrie
Nicholas J. Haritatos
Clifford H. Heslton
Henry G. Hohorst
Arthur F. Howard
Anthony Jamroz

Paul R. Johannessen
James K. Knowles
Harry S. Kradjian
Arnold G. Kramer
William H. Lane
Jack Larks
Daniel H. Lufkin
Robert M. Lurie
Paul A. Lux
Alex S. Malaspina
Edward J. Margulies
Edward K. Matthews
Michael Nacey
Kevork V. Nahabedian
Robert H. Norton
Eng Hung Ong
E. Ruiz De Luzuriaga
Clifford M. Sayre, Jr.
Stanley J. Solomon
H. Stephen Spacil
James I. Stockwell
James S. Stolley
James R. Strawn
Stanley H. Sydney
Donald F. Tarinelli
Emil J. Volcheck, Jr.
Seymour S. Weintraub
Andreas Wessel

1953
Ralph D. Anglin
David M. Berg
E. Fred Brecher
John R. Ehrenfeld
Norman C. Ford, Jr.
Morton J. Friedenthal
Gilbert D. Gardner
Albert W. Hecht, Jr.
George B. Hegeman
Lionel L. Kinney
David L. Klepper
Richard I. Linde
Richard S. Lindstrom
W. James Mast
John P. Medgyesy
Douglas L. Meyer
George J. Michel, Jr.
Floro D. Miraldi
Joan F. Mizer
John C. Morgenstern
William S. Nagel
L. N. Odenice
Robert R. Piper
Burton M. Rothleder
Stanley J. Sadowski
Paul P. Shepherd
Frank D. Skinner
Willard B. Spring
G. Harold Tseklenis
Tollyn J. Tweekell
Jon Van Winkle
Frederick Zwierling

1954
Gordon Aitken
Barbara B. Black
John Blair
Michael B. Boylan
Edward T. Brandt, Jr.
James W. Brown, Jr.
Donald L. Cassidy
Jerome Catz
Phil Chandler, Jr.
Jerome B. Cohen
Donald M. Dix
Edwin G. Eigel, Jr.
Inaki I. Elguezabal
Robert Evans, Jr.
Wilbur P. Fiske
Philip Gilbert
John H. Gusmer
Arthur W. Haines
James E. Hazard
Ernest C. Hinck III
Dean L. Jacoby
James E. Klapmeier
Stephen J. Lirot
Samuel J. Losh
Louis E. Mahoney III

Richard G. McKee
Leon D. Michelove
Aristides Miliotes
Avrom A. Mintz
Raymond D. Mintz
Harold W. Olsen
Luis E. Perez Olivares
George L. Perry
John M. Peterson
Frederick Rubel, Jr.
Francis J. Ryan
William H. Ryer
Philip R. Sayre
Marilyn L. Shilkoff
Charles M. Smith
Edward E. Smith
David F. Springsteen
Robert W. Stewart, Jr.
James R. Stuart
Robert J. Sukenik
George M. Thurlow
David C. Vogel
David B. Whelpley
Klaus M. Zwilsky

1955
Paul H. Attridge
John W. Blake
Edwin A. Chandross
Zaven A. Dadekian
Alan S. Dana, Jr.
Gilbert Davidson
William T. Deibel
Robert G. Dettmer
Robert G. Dunn
James H. Eacker
Philip N. Eisner
Eduardo L. Elizondo
Walter R. Fritz
Robert P. Greene
John F. Hayes
Robert H. Kohler
Warren H. Lattof
William B. Lehmann
Stephen B. Loring
Gerald P. Maloney
Thomas A. Marlow II
Richard B. McCammon
Wayne C. McClung
Sidney J. S. Parry
Frank E. Perkins
Charles T. Prewitt
Charles S. Robertson, Jr.
Randall S. Robinson
Walter Rubin
Walter G. Shifrin
Marianna P. Slocum
Allen G. Tarbox, Jr.
R. Peter Toohy
Philip A. Untersee
John F. Wing
Richard C. S. Yung
Jerrold Zindler
A. Lee Zuker

1956
George G. Alexandridis
Herbert S. Amster
Robert L. Barenberg
John P. Basile
Howard S. Bertan
Hugh E. Bradley
Bruce B. Bredehoff
Arnold P. Breedon
Paul E. Brown
John A. Buell, Jr.
Richard N. Carlson
Paul S. Cianci
Stephen N. Cohen
Michael G. Damone
C. Gerald Diamond
Charles W. Dietrich
Walter J. Farrell, Jr.
Franklin T. Flaherty, Jr.
Arthur Frank
Stuart Frank
Walter P. Frey
Samuel S. Friedman
Larry R. Goldberg

Kenneth E. Hickman
Robert J. Hochman
Charles P. Hoult
Richard I. Johnson
Evan T. Jones
Charles C. Joyce, Jr.
Joseph S. Kaming, Jr.
David L. Kaufman
Klaus Kubierschky
Charles L. Kusik
Merlin E. Lickhalter
Ronald J. Massa
Harold V. McKittrick, Jr.
Eugene Merfeld
John H. Merkl
Edward K. Moll
Clifford K. Monzeglio
Joseph T. Burval
Richard E. Norwood
Ira S. Polevoy
Anthony Praznik
Mrs. Bernhard W. Romberg
James A. Royer
John A. Seeger
Lester John Senechal, Jr.
Jerome Solomon
Walter R. Sooy
Lindley S. Squires
Robert L. Stapleford
John D. Stelling
Clarence G. Twohig
Paul Hermann L. Walter
Joseph L. Wauters, Jr.
Dexter R. Wheeler
Stanley T. Wray, Jr.
Thomas Yonker

1957
Paul G. Adler
Paul R. Ammann
Richard L. Baird
Laurence B. Berger
Arthur E. Bergles
Bruce Blanchard
Richard W. H. Bohlen
George H. Borrmann, Jr.
Allen G. Burgess
John T. Christian
Howard I. Cohen
Bernard R. Cooper
Stewart M. Crawford
Nelson R. Disco
Gordon S. Doble
David K. Donald
Alan D. Donaldson
Vincent L. Donlan
William H. Doughty
Paul E. Drapkin
Ronald E. Enstrom
Edward A. Friedman
Samuel J. Gerstenfeld
R. Bruce Grover
Eugene L. Hartman
Steven H. Hawkins
Frederick L. Jaggi
Malcolm M. Jones
S. William Linko, Jr.
Graham Lusk
Donald C. MacLellan
Russell L. Mallett
Richard M. McCabe
Terrence K. McMahon
Gerson E. Meyers
Richard R. Monsen
Frank E. Murphy, Jr.
Ross W. Newsome, Jr.
Donald A. Norman
Silverster Pomponi
Ralph C. Reynolds
Jared J. Safirstein
William H. Schoendorf
Herbert F. Schwartz
James G. Simmonds
Constantine B. Simonides
Ira Skalet
Robert M. Sterrett II
Erwin H. Straehley
Lavette C. Teague
Richard A. Wade

William R. Walsh
Ralph J. Warburton
Stephen Weisskoff
Richard V. Westerhoff
Richard P. Williamson, Jr.
Benjamin J. Woznick, Jr.
Roger L. Yaseen

1958
Arnold E. Amstutz
Hillel J. Auerbach
Karl K. Balbach
James G. Barber
David A. Berg
Cole Bess
Albert H. Brand
Michael E. Brose
Joseph T. Burval
Stephen Corman
Sheldon W. Dean, Jr.
John F. Fallon
Burton D. Figler
Richard A. Finn
Ernest R. A. Flemig
Willard E. Fraize
Richard M. Gottlieb
Stephanos S. Hadjiyannis
William R. Hauke, Jr.
Daniel J. Holland
Richard H. Hough
Dana Huestis
John C. Ingraham
Alan T. Johnson
Robert D. Jones
Lawrence S. Kaiden
Kenneth H. Langley
Paul R. Larson
King M. Lee
Hugh J. Murphy
John W. O'Brien, Jr.
Martin J. O'Donnell
Robert E. Oleksiak
F. W. Ostermayer, Jr.
Allen R. Philippe
Theodore M. Quist
David J. Rachofsky
Allan J. Rodolitz
Benedict P. Rosen
Paul H. Rothschild
Harold S. Samuels
John M. Seavey
Louis B. Seigle
Merrill Sidman
Matthew F. Smith
Steven R. Tannenbaum
Edward Wanger
Howard G. Ziff
Arthur L. Zimmet
Bazil R. Zingali

1959
Edward A. Ahlstrand
Barry Altschul
Edward J. Amrein, Jr.
Emile A. Battat
John H. Beynon
Bruce A. Blomstrom
James M. Bowers
Gary L. Bracken
John L. Brauman
James H. Brown
Herbert H. Champlin
Edward W. Cheatham
Charles S. Coffey
Louis Cohen
George H. Connor, Jr.
H. Roberts Coward
Dwight B. Crane
Gary L. Falkenstein
Jack M. Fischer
Martin J. Gruber
G. Neil Harper
Michael J. Haugh
H. Jan Heespelink
Robert E. Hillman
G. Richard Huguenin
Frank L. Hunsicker
Michael D. Intriligator
Herbert P. Kempe

Kent Kresa
Wilbur S. Latimer
J. Paul Leahy
Thomas B. Lovejoy
William M. Marcus
John K. Mitchell
James P. Moran
Oscar L. Morgenstern
Donald E. Murray
James A. Norris
David F. Pawliger
Leander F. Pease III
Carl H. G. Poedtker, Jr.
James E. Rogers
Robert L. Rosenfeld
Edward M. Safran
Oliver E. Seikel
Louis P. Seilo
Charles O. Staples
Lynn R. Sykes
Daniel I. Wang
Jonathan B. Weisbuch
Stephen K. Whittemore
Marie M. Wray
Stephen J. Yeretsky

1960
Ronald D. Agronin
Phillip B. Allen
Kurt M. Anderson
Paul F. Berg
Ronald M. Burde
E. Patrick Coady
John H. Connell
Charles R. Cushing
Charles J. Garbarini
Gary L. Gibson
Joseph I. Goldstein
Stanley H. Goodwin
Kenneth E. Hagen
Stephen E. Halprin
Charles H. Haspel
George P. Koo
Morris J. Kriger
Andrew Larsen, Jr.
Larry R. Martin
Kenneth T. McKie
Richard H. Oeler
Allan F. Pacela
Harold J. Parmelee
Igor Paul
Erik T. Ringjob
William M. Robertson
Howard L. Rosenthal
M. Elizabeth Schumacker
Anton Simson
Carl W. Swanson
Leonard B. Vaughn
Marc S. Weiss
Clay T. Whitehead
Raymond G. Wilkins
Christopher P. Witze

1961
John S. Benjamin
Gary W. Bickel
Alan R. Brennecke
Leslie G. Bromwell
Alan H. Cohen
Chandler K. Coyle, Sr.
Joseph T. Davis
Robert J. Dulskey
Dorsey C. Dunn
W. Mills Dyer, Jr.
Donald D. Easson
Reed H. Freeman
George W. Gladfelter
Bernard A. Goldhirsh
Jerry I. Goldman
Edward J. J. Grabowski
Peter R. Gray
William C. Grimmell
John S. Haggerty
Ted J. Hammack
George C. Harrison III
Thomas N. Hastings
Edward J. Hessler
Lawrence A. Horowitz
Daniel W. Kennedy

Joo C. Kim
Robert M. S. Kinney
John G. Layter
Kenneth J. Lembach
Joseph A. Lestyk
Donald G. Morrison
Donald G. Morrison
Robert S. Mroczkowski
Thomas P. Nosek
Aare Onton
Richard F. Otte
Pedro J. Piedrahita
Gerald E. Pollon
David B. Pratt
David A. Roberts
John E. Savage
Kenneth R. Scott
J. Curtis Shambaugh
Mannie Smith
Edward H. Sonn
Richard N. Spann
Nelson E. Stefany
Gilbert R. Stegen
C. Bruce Tarter
Peter Ver Planck
Ronald D. Wendland
Samuel J. Williamson
Ivar B. Yvisaker

1962
Jerry L. Adams
Jeremy E. Alperin
Robert E. Anderson
Lloyd Armstrong, Jr.
Alfred H. Bellows
Grant A. Beske
William D. Bloebaum, Jr.
Robert T. Brady
Peter Brown
W. Thomas Brydges III
V. A. Caravito
Alan L. Citron
Walter L. Colby III
Philip D. Cunningham
George S. Dotson
James Stark Draper
Dean E. Eastman
Edward A. Feustel
William J. Fry
Jeremy R. Goldberg
Gerald L. Gottlieb
Ben B. Gunter, Jr.
Dennis R. Hafemann
Rurik B. Halaby
Russell B. Ham
Richard G. Helmig
Jon M. Heuss
Richard L. Horttor
Jan T. Hyde
Michael H. Kaericher
James D. Miller
Keihachiro Moriyasu
Robert A. Morris
Robert F. Morse
Martin C. Poppe, Jr.
John E. Prussing
Chester H. Riley
Stephen C. Root
Darold W. Rorabacher
Allen H. Saye
Judith E. Selvidge
Peter R. Shrier
Steven J. Smith
H. David Stein
Norman D. Strahm
Gary M. Stuart
Roger J. Sullivan
Richard N. Sutton
William M. Taylor
Michael R. Terry
Robert L. Thews
Daniel E. Thornhill
Ronald R. Troutman
Melvin B. Weiss

1963
Paul D. Abramson, Jr.
Donald O. Benson, Jr.
Walter H. Berninger

Michael C. Bertin
Glen E. Books
Woods Bowman
Dean W. Boyd
Stephen B. Bram
Barton E. Cramer
Frederick E. Cunningham
Steven R. Ditmeyer
James E. Evans
John K. Flicker
Frank Y. Fradin
Anthony W. Geisler
Russell J. Gershman
Keith D. Gilbert
James L. Go
Thomas A. Goddard
Marley B. Herrin
Richard P. Hervey
Donald K. Joseph
John J. Lamberti, Jr.
James H. Latimer II
Robert M. Levin
Alan T. Marty
Robert M. Mason
Ronald W. Matlin
Kenneth C. Millett
Peter M. Mlynaryk
Frank S. Model
Robert H. Morse
Ruth R. Nelson
James W. Nick
Russell E. Prins
Alan O. Ramo
Daniel R. Ross
Michael J. Schaffer
Charles C. Schumacher
Charles W. Selvidge
Patricia C. Sherman
Bernard Slosberg
Raphael Soifer
Gene D. Sprouse
Frank O. Verlot
Roger N. Wallace
Ronald A. Walter
Robert A. Warman
John H. Wasserlein
William J. Wolf, Jr.
Bud C. Wonsiewicz
Boh K. Yap

1964
John C. Adamchak
Walter M. Anderson, Jr.
F. Michael Armstrong
Ralph R. Bestock
James A. Boiani
Wayne F. B'ells
Thomas B. Cheek
John L. Chiappetta
James I. Craig II
Bruce E. Crocker
Norman D. Davis
John P. Downie
Robert L. Fischer
Richard S. Fisher
James W. Giffin
Monte M. Giles
Steven J. Glassman
John N. Hanson
Robert H. Hobbs
Douglas J. Hoyleman
Mark Joseph
Philip S. Kilpatrick II
Bruce S. Knobe
Mark G. Lappin
Donald S. Levy
Roger K. Lewis
Richard G. Lipes
Carl L. Mampaey
William B. McClure
Serafin Menendez
Stephen B. Miller
Michael J. Monsler
Lita Donnelly Nelsen
William A. Nelson, Jr.
Herbert O. Norton
David R. Patterson
Robert P. Popadic
Richard D. Posner

John M. Rainier
Emma Root
Robert F. Saint-Aubin
David N. Saul
George T. Schmidt
Fred P. Silverstein
Wayne L. Stern
Samuel J. Taub
Jay M. Tenenbaum
Viguen R. Ter-Minassian
William L. Wallace
Henry B. Weil

1965
Warren L. Anderson
John F. Beckmann
Dennis P. Bekeney
Paul N. Blumberg
William H. Bohlke
Peter F. Brown
Stanley A. Brown
Edward A. Bucher
Edmund L. Burke
Pradip C. Burman
Arthur A. Bushkin
Ralph J. Cicerone
Mary E. Coffey
Stephen C. Dangel
J. Stephen Duerr
Michael Edessess
James L. Elliot
Sidney J. Everett
Jeffrey L. Forman
Louis A. Frasco
William T. Freed
Peter G. Gerstberger
Charles L. Gholz
Robert P. Goldberg
George L. Hadley
Thomas F. Hallam
Howard L. Helman
Robert D. Hempstead
George A. Herzlinger
Edward P. Hoffer
William N. Kavesh
David M. Kettner
Lionel C. Kimberling
Thomas R. King
Louis A. Kleiman
Peter R. Kornafel
David B. Liroff
Joseph A. Mangano
George C. McCurry
William H. Mooseker
Robert B. Morgan
Eric R. Morrow
Herbert W. Mower
Kayson Nyi
Piernaria J. Oddone
James R. Pearson
James T. Pepe
James M. Piepmeier
Alan L. Renninger
John D. C. Roach
Sharon C. Ross
Francis J. Russo
Wyckham D. Seelig
Charles D. Seniaewski
Peter Sexton
Yazan N. Sharif
Donald L. Shulman
Richard S. Shultz, Jr.
Philip E. Strause
Richard W. Sullivan
Bruce D. Sunstein
Ronald G. Tepper
Robert L. Waymost
Barry D. Wessler
Joel Westerman
Jarrod W. Wilcox
Stephen L. Williams
David L. Yuille

1966
A. Peter Adler
Joseph F. Adolph
James H. Batchelder IV
Kenneth W. Baxter, Jr.
Joel L. Berk

Franz X. Birkner, Jr. Joseph S. Bravman William J. Briggs W. Sumner Brown William L. Bunce William H. Byrn William O. Cain R. D. Camerini-Otero Alan J. Campagna Thomas A. Casey, Jr. Shao-Chung S. Cheng Richard A. Clark John W. Dawson, Jr. Donald L. DeAngelis James C. Deckert William T. Del Hagen William P. Dietrich Alan Dinner James C. Edgerton Christopher Egolf Omme W. Ellis Bert E. Forbes Frederick C. Furtek Lewis H. Gaines A. Mark Glickstein Paul G. Godfrey Henry T. Goldman Melvin H. Goldman James T. Gordon, Jr. Kenton A. Griffis Frederick Gruhl Alan R. Hirsch Stephen M. Hoffman Howard C. Hutt Robert R. Jackson Philip M. Jacobs Paul L. Kebabian Kenneth J. Kepchar Henry D. Kerr III Roger E. Koch Martin Krone James P. Lavine Paul F. Liao Gerald B. Lichtenberger Paul C. Lindsey, Jr. Peter E. Lobban Ronald E. Lundquist Gerald F. Madea Stuart E. Madnick Bruce A. Magness James L. Mannos Bernard F. X. Mathaisel William J. McGinnis, Jr. Karl G. Moller, Jr. Harry C. Moser Robert S. Pindyck Roland N. Pittman Harold Porosoff Allen E. Post Robert A. Pursell Joe M. Rife Michael D. Rinaldi Mark S. Schwartz Roy F. Schwitters Thomas A. Scott Joseph J. Shaffery Walter M. Shedd Barry P. Skeist Charles A. Smith Joseph I. Smullin Joseph W. Sullivan, Jr. Frank E. Surma, Jr. James L. Sweeney Peter W. Thomas R. William Thomas John Torode Stuart J. Vidockler Ronald W. Ward Robert A. Wells, Jr. Edward C. Wert H. Allen White III Barnet A. Wolff Jeffrey Wong Mark I. Yogman Robert S. Zucker	Platte T. Amstutz III Enrico I. Ancona Donald A. Belfer Victor M. Bermudez, Jr. Paul J. Caragine William L. Caton III Terry L. Collins John W. Cook John M. Davis Matthew G. Degnen Peter R. Denton Gordon J. De Witte Peter N. DiGiovanni M. William Dix, Jr. D. Travis Engen Barbara A. Gilchrist Mark R. Goldman Lewis B. Golovin Howard J. Greenbaum Lawrence C. Hall Alan B. Hayes Lutz P. A. Henckels Edson C. Hendricks Robert C. Hewitt Robert D. Howard Martin S. Kohn Charles E. Kolb, Jr. R. Mike Kruger Alan E. Kruse Allen M. Landers Andrew C. Lerner Eric K. Li Donald A. Mattes David McClain Douglas L. McCraith Charles V. Moran Victor Myev Donald R. Oestreicher Lin Olsen Robert L. Post, Jr. Stephen J. Rawlinson Adam V. Reed John C. H. Reykjalinn Stanley M. Rose Philip W. Rosenkranz James E. Rumbaugh George S. Sacerdote Chet Sandberg John M. Shufelt, Jr. Gerald B. Siegel Andrew D. Skibo Ivin Snyder Maurice H. Stauffer, Jr. Robert C. Todd James C. Tsang Eugene L. Venturini Glenn A. Wanek Jeffrey M. Wiesen John D. Wrigley, Jr. C. Leonard Zucker	Robert L. McCrory, Jr. John C. McFarren Charles B. Miller, Jr. Thomas M. Murphy William M. Parks Hughes Pope, Jr. Michael B. Rabinowitz Richard E. Reese Scott F. Richard David J. Roberts Joel P. Robinson Ronald S. Rosen Benton H. Schaub, Jr. Leonard H. Schrank Andrew Seidenfeld Robert M. Supnik Steven W. Swibel Michael G. Tashker Joel E. Tepper Kenneth P. Wacks Randall Warniers W. Stephen Wilson William G. Zink	Joseph L. Veranth Eben T. Walker Jeffrey M. Weissman Smith T. Wood Norman S. Yee Wayne A. Zafft	1970 Saud I. Al-Sowayel Richard A. Anderson Fred Andree O. Reid Ashe, Jr. Irving M. Asher Douglas F. Bender Stanley Bone Robert K. Bowden Gerald L. Brodsky James C. Bronfenbrenner Paul Burstein James L. Caldwell Steven C. Carhart Raymond C. Y. Chung Joanne H. Cole Stephen F. Cooper Carol Cunningham Robert A. Dangel Horatio G. Daub David P. Dobkin William N. Follette Robert M. Frankston James S. Gaetjens Robert G. Gerber Timothy M. Gilmore Carol A. Goldstein Robert F. Gonsett Marvin E. Greenberg Elaine D. Gruber Steven M. Haflich Geoffrey R. Handler John C. Head III C. Gordon Hunter Michael W. Hurst Jimmy J. Jackson Robert L. Jeffcoat Charles H. Karaian William J. Kennelly III Mark B. Ketchen David Koh Timothy D. Lundeen James M. Lyneis Anthony J. Malensek Paul Manooagian Clifford C. Marr James M. McCarthy Daniel A. McElwee John B. McLaughlin Robert C. Moore Robert S. Mullinax Gregory K. Palm William B. Parsons James M. Patell David T. Patten Anthony C. Picardi Francesco Pompei Lawrence P. Prier Howard J. Radin David M. Rapoport Christopher M. Rose James B. Roethnie, Jr. Anthony H. Russell David T. Schneider Walter W. Schroeder III Stanley Smilack Herbert F. Stevens Larry J. Stockmeyer Max Tabak Stephen R. Takeuchi Richard M. Tavan Tyler B. Thompson Harold M. Ting Marc Tipermars Walter E. Tuvel Michael S. Venturino Douglas M. Wells Bill K. Wong Man F. Yan	Kenneth A. Bauer Robert F. Beckley III Gregory K. Bernhardt Joseph K. Boddiford, Jr. Glen A. Brunk Robert M. Churella Jerry L. Crutcher Elizabeth A. Deakin Efstratios Demetriou Thomas H. Derby III Charles C. R. Dillon William N. Dix Robert C. Dresser Arnold S. Epstein Diane Feldman Eisenstat Edward T. Furrow Daniel J. Griffin Rene Manuel Haas John J. Halperin Randolph G. Hawthorne Gim P. Hom Martin L. Jack Travis H. Jackson Mehdi Jazayeri Thomas C. Kelly Jay S. Kunin Jeffrey D. Kurtze Gary H. Lantner David L. Lapidus P. David Lebling Martin B. Levin Robert P. Lidlal Robert E. Lindgren Timothy J. Maloney Robert D. Marshall, Jr. Mr Michael D. Mathers Robert E. Miegel Francis L. Miller Randall E. Moore Harold H. Nussbaum James G. O'Connell Jaime Olmos Kenneth W. Olson Paul D. Palmer, Jr. Judith L. Piggins G. Stephen Pittman William H. S. Preece, Jr. Robert H. Price David A. Rothenberg Bruce W. Rummel George W. Scherer Douglas W. Seitz Florence Sheehan Martin Silfen Alfred M. Solish Paul J. Sugarman Patrick B. Sullivan Alexander Sunguroff William J. Swedish Michael I. Titelbaum Gus J. Vlahakes Joseph B. Walters, Jr. Peter J. Wender R. Dale Zellers	G. Paul Hendrickson, Jr. Richard E. Henning, Jr. Steven J. Henry Thomas J. Humphrey Elizabeth A. Hutchins Harlan E. Ives Hans W. Khimm Timothy C. Kiorpes Norman V. Kohn Bruce G. Laird Janet S. Lantner Robert G. Lee Richard B. Levin Lynn Mahony Charles E. Mann Timothy B. Mapstone Michael K. Martin Paul B. McBride Richard D. McRoberts Donald S. Purgess Darrell S. Rigel James W. Roxlo Jeffrey B. Rubin Steven K. Schuster Leonard H. Sigal Dean Solomon Joseph S. Stapczynski, Jr. B. Katherine Swartz Michael F. Sweeney John W. Taylor Frank J. Tolve, Jr. Nagasato Uchida R. Daniel Witschey, Jr. Albert S. Yee	1973 Clifton P. Allen Bertrand C. Barrois Jay F. Benesch John R. Bertschy Peter G. Borden Roger P. Bowers Sally J. Boyson Maria A. Bozzuto Daniel Bricklin Donald K. L. Chao Vincent F. Chiappetta George T. Chiu Frans Christ Alan Cisar Mary Jean Crooks Jamie P. Eng John R. Gersh Mark S. Glasser Mateo Go Jr Paul A. Green II Joseph G. Hadzima, Jr. Nicholas T. Hamisevicz Roderick John Holland, Jr. Doron C. Holzer Debra R. Judelson John E. Kaufmann Sherry Horn Kesden Lisa C. Klein Roger D. Lace B. John Lange III George R. Langlais David Lee Jack A. Levy Patrick A. Marcotte Howard Messing Robert B. Millard Robert L. Miller, Jr. Joseph H. Mirzoeff Brian W. Moore David J. Moylan III Mark Carroll Oakes Forrest A. Price Ellen E. Reintjes Martin Romeo Alan G. Spoon Thomas R. Stagliano Cynthia Day Stratton Paul A. Swartz William W. Toy John C. Weaver Lawrence E. Widman James S. Wiley III David R. Wilson	John D. Wright Charles A. Ziering, Jr.	1974 David C. Aldrich Edwin M. Aripoll Anne E. Bossi Ludwig C. Chang Brymer Han-Yu Chin Robert M. Colopy Frank Commons Piero DiCapua William Lloyd Donner Michael Peter Filosa James Richard Groff Edward J. Hanley, Jr. Richard Alan Hartman Rodney C. Hartman Michael J. Hassett Charles Edward Hillman Esther Ming Hu Bruce Irwin Judelson Bruce A. Karmel Clyde Alan Kessel John Brown Miller Harold Milstein Andrew W. Moehlenbrock Barry N. Nelson Amos Oshrin Seth M. Powsner Gary David Raymond Laurence H. Reece III Tim Reiser J. Alan Ritter Brian John Rossin Elizabeth Lam Schreuren Bruce Brian Schreiber Scott Howard Shlechter Jonathan Bart Tepper William H. Thoms John Paul Tierney, Jr. Alan L. Unemori Jay W. Van Dwingelen Jeffrey C. Weinreb Douglas W. White W. Paul Zampol	1975 John H. Austin Wesley S. Blank Peter P. Blanshan Diane F. Bracken Patricia R. Callahan David W. Chen Hon Wah Chin Harold M. Cook Saleh Daher, Jr. Mark R. Dahl Kenneth M. Deemer Joseph W. Dehn III Natalie J. Dehn Leonard J. De Roma Loren E. Dessonville Thomas Durgavich Alan G. Epstein Howard M. Finkelstein Dennis R. Fromholzer Susan A. Fuhrman Robert J. Gandelman Daniel M. Gantt Ilene S. Gordon James A. Hayter Henry G. Heck Eve J. Higginbotham-Williams Donald W. Inadomi B. Anthony Isaac Kenneth J. Isaacson Christopher L. Jans Pamela J. Jorgensen Frank Klotz Michael G. Kozinetz II Edmund K.-L. Lau Michael Lebowitz Thomas Glen Leo Alan E. Levin Peter J. Mancuso Carol M. McGuire R. Scott McKenzie
1967 John Acevedo Joseph W. Alsop II				1971 Richard A. Aparo						

Thomas F. McKim
Andrij R. Neczwid
Paul I. Pilorz
Norris W. Freyer, Jr.
Arthur P. Rosiello
Paul J. Sanchez
Alan J. Schimmel
Daniel R. Sempolinski
Paul H. Siegel
William M. Silver
Therese M. Smith
Joseph A. Sorge
Richard M. Stratt
Clifford L. Wald
David P. Weilmuenster
Arlo F. Weltge
John B. Wilbur III
Michael E. Wilens
Anthony J. Willmer
David C. Yauch

1976

Robert J. Aquadro
David A. August
Hal M. Berman
Robert S. Blau
Raphael S. Blumkin
Michael A. Bookman
Irene Y. Chan
Thomas P. Chang
Elliot K. Chartash
Jessie R. Chermak
Marilyn Taggi Cisar
Bert Daniel
Roy E. De Meo, Jr.
Michael W. Dziekan
James K. Falbo
Andrew S. Farber
Charles Frankston
Harry Frischer
H. Lee Gearhart
Barry Goldman
Jay D. Gurley
John J. Hanzel
Mark A. Holthouse
Richard A. Inz
Douglas M. Johnston
Neil E. Kaden
Lawrence Kernan
Forrest N. Krutner
Todd R. Kushner
Campbell M. Lange
Gustav Laub III
David L. Lee
Reynold Hans Lewke
Michael C. Lynch
Kelly P. McClellan
Roseanna H. Means
William H. Menke
Jerry D. Metz
James S. Miller
Kenton C. Murphy
Janis B. Ossmann
Wendy Peikes
Burt L. Rubenstein
Frank A. Ruiz
Linda Sax Crossland
John D. Schoedel, Jr.
Daniel Seligson
Deborah Stein Sharpe
David C. Shaver
Susan Lyon Smolinski
Charles A. Sommer
Jack H. Stevens
James P. Wajda
Gail M. Walker
Lindsay A. Weaver, Jr.
John E. Wiele
Franklin E. Withrow III
Benson K. Woo
Steven L. Zeitzew

1977

Andre K. Y. Au
Wayne D. Baron
David R. Bieberle
G. William Brown, Jr.
Richard W. Buck

Stephen G. Cecchetti
Michael C. Cohen
James E. Corning
Robert S. Cotta
David A. Dobos
Daniel I. Drake
Bruce E. Edwards
Solomon R. Eisenberg
T. M. Eubanks
Leonard N. Evenchik
Paul E. Fallon
Thomas B. Fetter
Peter J. Fiekowsky
Todd S. Glickman
Thomas C. Gooch
Robert S. Granetz
Michael J. Haney
C. Douglas Howard
Joan M. Hughson
Thos A. Kush
Manuel T. Lowenhaupt
Douglas J. McLeod
Paul R. Menard
Kevin B. Miller
Thomas C. Mills
Charles G. Mogged, Jr.
Timothy F. Morison
Russell T. Nevins
John J. Nugent, Jr.
Robert M. Russ, Jr.
Richard M. Smiley
Michael W. Sonnenfeldt
Steven H. Spiro
Leslie Faye Sutton
Mox Tan
Barbara A. Thornton
L. Watlington
Steven J. Weissburg
Keith B. Weldon
William F. Whitelaw
Robert L. Willmore

1978

Howard S. Baron, Jr.
Kevin F. Brennan
Alice E. Campbell
William Ceruzzi
Trieu C. Chieu
Fern L. DoVale
William T. Fejes, Jr.
Debra A. Utok
Paul E. Vianna
Robert V. Vieraitis, Jr.
Daniel C. Vogel
William R. Welke
Walter J. Zielenski III
John N. Little
Nancy T. Lukitsh
Carl D. Lutz
Donald B. Mellen
Naomi Johnson Miller
George M. Orlov
Anthony L. Otten
Cordelia M. Price
John E. Swindle
Marc J. Truant
Steven C. Webster
Arthur Wright

1979

Douglas C. Barnard
Lisa M. Bendixen
Thomas D. Berman
Tim E. Blimptis
Panayotis E. Cavoulacos
Susan Jane Colley
Hoyt L. Davidson
Keith L. Dimorier
Richard W. Dykstra
Jim Feeney
Pryor A. Garnett
Robert E. Gompf
Marcia H. Grabow
Norman R. Guivens, Jr.
Jan S. Hack Katz
John D. Helferich
David A. Holt
Charles W. Jackson

Donald Jue
Stephen K. Kenda
Sally C. Kornfeld
Richard P. Kuntz
David R. A. Lewis
Gerald T. Michael
David D. Miller
Barry A. Newman
Lee S. Parks
Brenda Pomerance
Jonathan A. Reiss
Bruce J. Roberts
Larry S. Rosenstein
Charles B. Roxlo
Carlo R. Russo
Jeffrey I. Schiller
Kenneth J. Schroder
Michael A. Tarsi
Carol Cesari Tourgee
Scott H. Wayne
Edmund L. Weston III
Ronald M. Wexler
Eric N. Whitney
William T. Wood

1980

Frederick D. Baker
Jeffrey H. Berman
Russell Blount
Thomas S. Borecki
Rodney D. Cadanau
Jane H. Chronis
Thomas A. Curtis
Gustavo de los Reyes
Andrew D. Fately
Jean Fischer Bandy
Susan B. Gaughan
Ralph A. Hulseman
Jeffrey M. Jaycox
Eric L. Kahn
Timothy J. McManus
Joan W. Miller
Terry S. Neiman
Scott A. Norton
Kenneth D. Oya
Brian J. Picht
Martin G. Plys
Howard W. Seidler
Susan J. Tiffany
Richard W. Tucker
Debra A. Utok
Paul E. Vianna
Robert V. Vieraitis, Jr.
Daniel C. Vogel
William R. Welke
Walter J. Zielenski III

1981

Robert B. Ashton
Michel B. Bayloq
Aaron F. Bobick
Mitchell P. Brook
Lance H. Choos
Lauren A. Christopher
Timothy P. Cleary
Tso Yee Fan
John R. Fierke
Ellen C. C. Fischer
Deborah A. Galaska
Joel T. Garcia
Mark Hellinger
Louisa Ho
Roger A. Ishimoto
Joseph J. Kesselman, Jr.
Chun-Chee Lau
Judith K. Lemire
Lynn Radlauer Lubell
Paul R. Marcus
Charles R. Markham
Kenneth Alex McDonald
Duane T. Nakahata
Richard Park, Jr.
David L. Pinckney
Eric S. Sklar
Pamela G. Standley
Douglas S. Swanson
Daniel C. Tappan
Jeffrey C. Tung
William A. Watkins

Joy A. Weiss
Christopher S. Wheeler
Dale E. Zimmerman

1982

Arno S. Bommer
Beverly F. Borden
Michael J. Colucci
Michael G. Feinstein
Charles Frankel
Linda M. Garverick
Craig V. Hawkins
Fred W. Helenius
Kurt B. Johnson
Bob Johnson
Matthew D. Kallis
Bruce A. Kiernan
Grace L. Malloy
Cynthia H. Nicholson
Matthew Prete
Alan T. Rath
Andrew W. Reddig
Monica M. Reynolds
Philip B. Romanik
David I. Solo
David B. Teller
Mary A. Wright
Chi-Won Yoon

1983

Lisa M. Anderson
James E. Colgate
Paul S. Cunningham
Paul O. Detwiler
Brisford B. Flint
Norman L. Fortenberry
Matthew K. Haggerty
Marvin Hom
Lawrence J. Kaufman
Kenneth W. Krugler
David A. Lefebvre
Barry Margolin
John E. Mracek
George J. Normann
Gary A. Oliverio
Hyun-A. C. Park
Brian W. Pontius
Andrew M. Robbins
Eileen R. Seligson
Patricia A. Smith
Jeffrey W. Stevens
Simon D. Trieu
Robert Varkonyi
Roy M. Weinstein
Jonathan G. Young

1984

Eric Burger
Steve M. Dubnik
Richard B. Feldman
Kenneth R. Grant
William M. Haney
Ralf Harteneck
Michael T. Howard
Charles J. Levine
Chunka Mui
Michael J. Repeta
Jeffrey L. Schenck
Valeri H. Terry
Kenneth R. Traub

1985

Michael M. How
Jeffrey S. Moore
Gail S. Nonnemacher
Peter A. Quigley
Jon A. Rochlis
Stephen N. Schwoerke
Kevin E. St Onge
Andrew B. Wescoat

1986

Steven L. Gaiser
Ka Fai Ho
Paul A. Moschetti
Mary C. Ystuetta

1987

William H. B. Haback

Steve C. Sherwood
Hong M. Yang

1988

Christine A. Chu
Barbara J. Sannwald

Advanced Engineering Studies

Harold H. Leach '70
Yasuro Mizuno '90

Aeronautics & Astronautics

William B. Abbott III '61
Holt Ashley '51
Richard L. Barkley, Jr. '68
Bruce B. Blake '57
Hugh J. Campbell '53
Wai K. Cheng '79
Tze-Thong Chien '72
Brent R. Collins '81
Eugene E. Covert '58
Stephen C. Ellis '85
John I. Erdos '65
Walter A. Foley '70
Howard J. Gibeling '72
John T. Harduvel '72
Thomas J. Harriman '43
Thomas M. Humes '76
Gaylord MacCartney '53
John J. Mahoney '54
Thomas A. McMahon '70
Edwin N. Myers '61
Theodore H. H. Pian '48
Paul E. Pirtle '64
John G. Ryan '60
George S. Schairer '35
Leroy P. Smith '49
George Stalk, Jr. '74
Robert A. Summers '54
Hironori Takahashi '70
Alan L. Weinberger '61
Thomas F. Wiener '62

Architecture

John Manning Baldwin '74
Edward J. Burnell III '66
Mark H. Butler '79
Nedret T. Butler '76
Maurice F. Childs, Jr. '60
Vladimir N. Dackiw '85
John R. Dale '86
Paul R. Dermanis '59
Earl R. Flansburgh '57
Nancy Lynne Goodwin '74
Susan Greenwald '76
Ernst A. Ibs '66
Toufic E. Kadri '82
Harris A. Kemp '37
Woo-Sung Kim '72
Ernest E. Kirwan '59
Dan R. Malamuceanu '84
Marian S. Moffett '75
Rafael Obregon Herrera '72
G. Robert Parker, Jr. '70
John W. Peirce '47
Anthony C. Platt '69
Richard C. Reece '50
Ronnie E. Rogers '73
Carol Shen '71
Norris Strawbridge '76
Peter C. Sugar '60
Ewart A. Wetherill '58
John A. Winslow '80

Biology

Frederick M. Ausubel '72
Russell Kuo-Fu Chan '74
David A. Gubbins '81
Edward S. Josephson '40
Cecily C. Selby '50
Jacob Struck, Jr. '58
Alfred M. Webb '47
J. M. Williamson '78

Center for Real Estate Development

David G. Bloore '89
Henry G. Brauer '87

Dennis P. Geoghan '86
Maria D. Hill '86
Don Klabin '85
Stephen J. Murphy '87
Randy G. Nichols '89
Daniel A. Pedrotti, Jr. '88
Brian S. Rein '88
William Schein '87
Paul D. Sehnert '88
William A. Swiacki, Jr. '87
Kathleen Weremiuk '87
Latham L. Williams '86
Suzanne F. Williams '86
John C. Wolter '86

Chemical Engineering

Thomas M. Bartos '85
Ronald O. Baukol '60
Michel L. Besson '60
Rowland S. Bevans '46
Robert E. Bohman '77
P. L. Thibaut Brian '56
James S. Bruce '39
Carl F. Cast '41
Tsuan Y. Chang '38
Michael C. Chen '73
Ming-Ming L. Chen '73
Bernard Chertow '48
Chai Y. Choo '60
Timothy J. Coleman '34
Robert W. Davis '50
Pablo G. Debenedetti '85
Bradley Dewey, Jr. '40
Stephen C. Dodd '76
Robert H. Fariss '51
Austin W. Fisher, Jr. '41
Raymond K. Flege '32
John Forgrieve '50
William K. Fraizer '80
Robert A. Frey '43
Manfred Gans '51
Joseph M. Garzer Bruna '71
Michael S. Gerstein '64
Howard Grekel '47
Robert D. Hawthorn '54
Arthur E. Higginbotham '60
Allen F. Horn '84
Edward C. Hume III '83
Shingo Ishikawa '79
Hugh Robert James '74
Douglas L. Johnson '53
James R. Katzer '70
William E. Kennel '47
Howard Klee, Jr. '72
Michael T. Klein '81
William C. Krumrei '51
Miles C. Leverett '38
Yi Hua Ma '67
Frank M. Majewski '34
Charles P. Marion '52
Terence C. McDonald '84
Edward W. Merrill '47
Carl S. Minden '47
Timothy Lee Montgomery '74
Albert L. Moore '58
William M. Murray, Jr. '55
James P. Noyes '53
Stephen A. Odio '90
R. Robert Paxton '49
Donald W. Peaceman '51
Frank G. Pearce '46
Lockwood Rianhard '54
Ricardo C. Rizo-Patron '79
Murray W. Rosenthal '53
George F. Schlaudecker '39
Hugh W. Schwarz '42
James Seth '36
Francis L. Shackelford, Jr. '40
Robert E. Siegfried '47
Robert S. Smith '47
George A. Sofer '50
Bayard T. Storey '55
Carl W. Streed '41
T. J. Suen '35
Jefferson W. Tester '71
Preetinder S. Virk '67
Willard F. Wadt '33
Douglass J. Warner '59
Halsted R. Warrick '32

James C. Wei '54
John A. Wilkens '77
Lucile S. Wilkens '77
Glenn C. Williams '42
Byron B. Woertz '39
Kwang J. Won '79
Patrick S. Wong '62
Pang Tsu Woo '51
W. Kelly Woods '36
Larkin T. Wyers, Jr. '43
En S. Yoon '82

Chemistry

George A. Auld, Jr. '68
Lawrence N. Bell '68
Rene R. Bertrand '62
Kofi Bimpong-Bota '75
James J. Bishop '69
C. John Blankley '67
Lawrence H. Bowen '61
Carl H. Brubaker, Jr. '52
Robinson D. Burbank '50
John A. Carlson '68
Howard S. Corey, Jr. '55
Theodore W. Craig '66
C. Doyle Daves, Jr. '64
Susan M. Fredericks Davis '80
Donald R. Doulsin '48
Hugh L. Dryden, Jr. '50
Gareth R. Eaton '72
Sandra S. Eaton '72
Richard P. English '70
Anthony B. Evnin '66
Louise H. Foley '70
J. Stuart Fordyce '59
Lionel S. Galstaun '34
Robert B. Giles, Jr. '44
A. Thomas Hallowell '40
John W. Irvine, Jr. '39
Harbo Peter Jensen '74
Frederick O. Johnson '50
Christopher E. Kalmus '72
Dieter H. Klaubert '71
Robert L. Lambert, Jr. '73
Leo A. Landers '52
Hiok Huang Lee '56
Kenneth D. Legg '69
Linda D. Lu Chang '82
Robert R. Luise '70
Joseph X. McDermott '75
Robert C. Michaelson '76
William C. Mills III '81
Stephen A. Monti '64
Harold R. Nace '48
William D. Phillips '51
John Piper '60
Gary H. Rasmussen '62
William Larry Respass '64
Joseph E. Rousseau, Jr. '52
Hubert J. P. Shoemaker '76
Edward T. Shaul '70
Emil J. Slowinski, Jr. '49
Donald M. Smyth '54
Charles G. Wade '65
Chin-Hsien Wang '67
Richard L. Wasson '56
Frederick K. Watson '36
Emily L. Wick '51
Randall B. Wilson '79
Robert A. Young '68

Civil Engineering

Thomas W. Anderson '37
D. C. Angelides '79
Joseph Antebi '57
Lionel Bauduy '69
Berghold Bayer '70
Fredric S. Berger '84
Richard B. Bovee '70
Shing-Ching Chan '71
Visaril Chowchuvech '56
Kenneth C. Deemer '52
Roger Foott '73
Stuart A. Freudberg '77
Justin J. Gershuny '53
Thomas F. Gilbane, Jr. '75
Robert L. Hardison '63
Donald R. F. Harleman '50
Thomas N. Harvey '72

- Kent A. Healy '63
Yoshihiro Ichikawa '68
Jan M. Jordaen, Jr. '55
D. C. Koutsoftas '72
Thomas D. Landale '54
Norman W. Llewellyn '49
Richard C. Lundberg '66
William O. Lynch '47
Chi-Kuo Mao '83
Fujio Matsuda '52
James H. Maxymillian '61
Johann H. Meier '38
Harley L. Moore III '73
Yasuo Mori '68
Yuichiro Motomura '74
Tavit O. Najarian '75
Edward E. Newman '57
Saul A. Nuccitelli '60
C. Andrew Pretzer '63
Asaf A. Qazilbash '65
Ann B. Rappaport '76
Joseph J. Rixner '68
Arthur C. Ruge '33
Jacob A. Samuelson '40
Neil S. Shiffrin '80
Brice R. Smith, Jr. '52
M. Llewellyn Thatcher '72
Max M. Ulrich '51
Senol Utku '59
Horacio Velasco '86
Miguel P. Velez Rodriguez '57
Polyvios C. Vintiadias '61
Charles R. Walker '48
John D. Y. Wang '75
Louis M. Wenick '77
Stanley M. White '66
Robert L. Wilcox '55
P. Huey Wong '46
Michel H. Zaleski '71
Daniel Zielinski '75
- Earth, Atmospheric & Planetary Sciences (includes Meteorology)**
Carlton M. Beall '42
James L. Bierkaas '77
Walter F. Bohlen '69
Albert M. Bottoms '62
Roger J. Breeding '70
Norman M. Brenner '75
Mackenzie L. Keith '39
Edward N. Lorenz '43
Carla W. Montgomery '77
Harold J. Noyes '75
Thomas B. Sanford '67
Peter R. Tatro '66
- Economics**
Marcelle V. Arak '67
George B. Baldwin '52
Ellen Burton '82
Sidney E. Chernick '56
Leslie Cookenboo '53
M. Louise Curley '46
Patricia M. Dinneen '80
Harold E. Dreyer '52
Ann F. Friedlaender '64
Vernon H. Grigg '54
Harry Grubert '68
Thomas G. Hall, Jr. '52
James W. Hanson '52
William C. Hollinger '53
Shinichi Ichimura '53
William W. Keefe '50
Catherine L. Mann '84
John M. Marshall '69
David S. McClain '74
Robert C. Merton '70
J. Wade Miller '48
Nicholas S. Perna '69
Michael A. Salingier '82
Charles Steindel '77
Charles J. Stokes '51
- Electrical Engineering & Computer Science**
Emmett H. Bradley '50
Abraham Y. Chen '70
Ta-Kuan Chiang '61
- William H. Crabtree '62
John R. Cummings '57
Wilbur B. Davenport, Jr. '43
John E. Dawson '78
Charles A. Desoer '53
Anthony P. Di Vincenzo '47
Michael D. S. Donovan '64
Heinrich A. Ernst '59
Robert R. Everett '43
Jerry J. Farrell '73
Dennis M. Freeman '86
Robert G. Gallagher '57
Frederick L. Hafer '50
Susan A. Hall '82
James M. Ham '47
Hermann A. Haus '54
Frank Ianna '72
David L. Isaman '79
Philippe A. Janson '76
Bartley C. Johnson '86
George E. Keith, Jr. '62
Wolfgang Kohn '74
Ernest R. Kretzmer '46
Gordon M. Lee '44
Charles I. Malmie '58
Robert L. Massard '50
Solomon M. Max '59
Charles W. Merriam III '55
Joseph J. Mezrich '70
Edgar A. Miller '67
Paul M. Murphy '40
Carl E. Nielsen, Jr. '58
Eni G. Njoku '76
Louis L. Odette '81
Edward R. Orear '49
Douglas B. Paul '76
Stewart D. Personick '70
Clark J. Reese '70
James R. Relyea '58
Richard J. Robbins '70
Adel A. M. Saleh '70
Louis D. Smullin '39
William M. Snyder, Jr. '39
Thomas L. Sterling '84
James R. Stinger '72
Paul E. Stoft '49
Robert Stricker '70
Walter A. Sturm '57
John D. Summers '84
James M. Tien '72
Mark A. Townsend '37
John C. Ufford '75
Kenneth A. Van Bree '71
Mac E. Van Valkenburg '46
James L. Walker '67
David C. Whipple '48
Gifford E. White '41
John G. Whitman, Jr. '62
Paul R. Wickliffe, Jr. '51
Katsumi Yamane '71
Stanley R. Zanarotti '89
Howard M. Zeidler '43
Henry J. Zimmermann '42
- Graduate Management**
Dan I. Abrams '65
James B. Adelson '79
Ollie J. Akef '67
Jesus A. Alvarez-Morodo '74
Jerry D. Bailey '79
Henry B. Barg '73
Bruce S. Baron '87
Jesus L. Barrera Lozano '78
Katherine J. Bishop '71
Charles R. Bland, Jr. '80
Antonio Bonet Madurga '89
Peter B. Bowman '73
Kevin Brau '90
R. Klaus Brauer '79
Joseph R. Brenner '57
Alfred I. Camhi '60
Jonathan D. Casher '69
F. Hudnall Christopher, Jr. '59
Robert L. Clyatt '85
Frederick L. Cohen '80
Neil L. Cohen '86
Joseph Combs '77
Peter J. Condakes '80
Walter T. Conway, Jr. '72
- William Elbert Cook '74
Allan B. Cruickshanks '82
J. Eric Daniels '75
Dennis F. Delavara '64
Richard A. Derbes '70
Adam M. de Sola Pool '88
Pierre J. de Weck '76
Peter F. DiGiammarino '77
James E. Donaghy '58
Mark F. Donato '84
Alexis Driscoll '84
Paul L. Eckbo '76
Peter D. Englander '77
Raymond J. Epich '54
Karen C. Evans '87
Agnes Farris '74
Frank E. Ferguson '59
Lauren L. Flannery '80
Susan J. French '77
Michael G. Frieze '62
Peter D. Gantchew '87
Gordon D. Garmaise '73
Bruce R. Gee '86
Peter J. Genta '89
Edward M. Giles '59
Richard B. Gillett '52
William F. Glaser, Jr. '57
Ernest I. Glickman '64
Richard A. Goodman '62
Kenneth F. Gordon '60
Frank C. Graves '80
John M. Greenwood '72
Michael J. Halloran '83
Robert J. Hamada '69
Miles M. Harbur '77
Beverly Chapman-Hamman '78
John V. Hedberg '50
John M. Hennessy '70
Winston R. Hindle, Jr. '54
Creighton G. Hoffman '70
John H. Hubbard '63
Donald L. Isaacs '74
Laurence B. Jacobs '69
Ronald R. Jensen '65
Clay Johnson III '70
Philip Loring Johnson '74
Paul David Kaplan '74
Ellen S. Karp '72
Marzio Keiling '90
Norman K. Kidder '75
Edward A. Klepacki, Jr. '76
Laurence F. Klurfeld '72
Mahesh K. Kotecha '74
Lawrence A. Krakauer '80
Jolene Larson '80
Eric R. Lee '62
Carl P. Lehner '80
Paul H. Levy '77
Leon H. Liebman '67
Leonard M. Lodish '68
Anthony J. LoFaso '85
Benjamin D. Lorello '77
John R. Macheras '86
Maurice E. Maertens '66
Nikhil Malvania '78
Susan Helene Martin '90
Bruce A. H. McFadden '75
Richard A. Michaels '77
John J. Mikulsky, Jr. '73
Howard F. Miller '61
Frank A. Mizuno '83
James L. Monroe '85
Kenneth P. Morrison '83
Margaret V. Mulley '78
Scott A. Neslin '78
Axiel M. Neubohn '65
Kenneth M. Neuhaus '78
Assen Nicolov '77
Niels P. Nielsen '90
Emmanuel Nana Njomo '74
Robert W. Norris '63
Emery G. Olcott '63
Robert M. Packer '83
Mrs. Edward M. Peacock '47
Mark B. Pearlman '78
Shripad G. Pendse '67
D. Bruce Peterson '70
Daniel A. Picard '72
John E. Pototsky '78
- Mark R. Proft '88
Thomas L. Pugliese '86
Frederick J. Quinlan '81
Richard A. Rabinow '68
Mark Regan '83
Raymond F. Rogers '48
Terry W. Rothermel '70
Felipe Ruiz-Lopez '75
Norma S. Sarofim '72
Leslie Schine '77
Robert A. Schmitz '65
R. Gary Schweikhardt '73
James H. Selbert '66
Eldon E. Senger '71
William A. Shaffer '76
Paul E. Slobodan '83
Jamie A. Smith '82
Dan S. Somekh '67
Steven P. Somes '83
Fred I. Steele '65
Marc H. Steglitz '65
James A. F. Stoner '61
Shivan S. Subramaniam '78
Robert L. Sutherland '73
Anne Symanovich '77
Masataka Tamura '73
Kong-Heong Tan '71
Michael L. Tushman '76
Monica Villegas Tomlin '76
William E. Wade '68
David A. Weber '83
Robert Cayleiff Weiss '74
George H. Windecker, Jr. '76
William S. Wong '88
Richard R. Wood '48
Earle Yaffa '63
Carlos E. Zaragoza '70
- Materials Science & Engineering**
Diran Apelian '73
Aziz I. Asphahan '75
Michael B. Bever '42
Donald J. Blickwede '48
David S. Bloom '47
Relva C. Buchanan '64
Thomas R. Clevenger, Jr. '61
Peter K. Domalavage '80
William B. Eisen '68
John F. Elliott '49
Alan T. English '63
Douglas W. Fuerstenau '53
Tasuku Fuwa '58
Stefan J. Garvin '50
Vernon Griffiths '55
George A. Keig '66
Maharaj K. Koul '68
Richard C. Krutenat '65
Joseph R. Lane '50
Robert D. MacDonald '40
George E. Nereo '63
John E. Niesse '56
Walter Nummela '63
Stanley Y. Ogawa '60
Bruce S. Old '38
Richard F. Polich '65
Svante Prochazka '68
Robert C. Ruhl '67
Nannaji Saka '74
Robert E. Savage '47
Reinhardt Schuhmann, Jr. '38
Italo S. Servi '49
William F. Smith '68
Min-Hsiung Tsai '72
Johannes M. Uys '59
A. Robert Wasson '78
Stanley Weiss '55
David O. Welch '62
Frank E. Woolley '66
- Mathematics**
Bruce H. Baguley '75
Alan E. Berger '72
Joseph J. Buff '77
Pierre A. Carrus '49
Robert A. Clark '49
Phyllis Fox '54
David S. Johnson '73
Victor F. Klebanoff '76
- Hisayosi Matumoto '88
Robert F. McIntosh '51
Hironori Onishi '61
Anthony H. Palmer '60
David P. Robbins '70
Larkin R. Scott '73
Nancy K. Stanton '73
Norton Starr '64
Torgny Svanes '72
Bui A. Ton '64
David A. Vogan, Jr. '76
Dale R. Worley '84
- Mechanical Engineering**
William M. Brobeck '33
Christopher Calia '81
John C. Chato '60
Aniruddha D. Chitale '68
Lawrence S. Daniels '66
Wilfrido R. Espanola '76
Woodie C. Flowers '73
Donald A. Gall '58
Francois L. Giraud '50
Albert J. Glassman '59
Norman A. Gray '84
Lorne G. Greenwood, Jr. '61
Charles C. Hansen III '47
Serope Kalpakjian '53
Peter Kalustian '34
Enrique L. Kilayko '60
Kenneth Koenig '70
Noriyuki Kouguchi '66
George A. Lavoie '70
Lloyd J. Lee '61
Lawrence H. Linden '76
Francis S. Lynch '68
Harold M. Matheson '57
Bora Mikic '67
Marlen L. Miller '54
Vinay K. Nagpal '69
John I. Simpson '69
Watson E. Slabaugh '30
Joseph L. Smith, Jr. '59
Arthur M. Spiro '47
Bryon W. Stutzman '66
Kwai-Yung B. Su '80
Mrs. Hal R. Terwilliger '33
Jan A. Veltrop '53
Chiao J. Wang '46
Paul A. Wieselmann '69
Leroy C. Worley III '73
- Nuclear Engineering**
Dennis C. Bley '79
Harry J. Capossela '68
William R. Corcoran '71
Robert W. Davis '80
Michael J. Driscoll '64
Donald R. Ferguson '71
John S. Hendricks '75
Tsing T. Huang '87
David D. Lanning '63
Charles L. Larson '59
Richard K. Lester '80
Lou R. Pasquarelli, Jr. '76
Robert I. Schermer '61
Howard C. Shaffer III '76
Michael Todoros '77
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BY PAMELA VARLEY

Electronic Democracy

The citizens of Santa Monica

use computers to talk with City Hall and each other.

Is the system a state-of-the-art town meeting.

or just a glorified call-in show?

W

ITH its enticing beaches, gourmet eateries, zany public artworks, and radical-chic sensibility, Santa Monica has long been known as a playground for celebrities and affluent tourists. But the residents of this gleaming seaside town in Southern California are lately putting their community on the map for yet another reason: a curious social and political experiment. The idea is to create a new kind of public meeting ground—different from City Hall, different from a city park or plaza—where citizens can talk to public officials and city servants on equal footing, where people can get to know one another in safe environs and chat about local political issues or anything else on their minds.

This egalitarian meeting ground—where all voices are equal, anyone can speak at any time, and no one can be silenced—is not a physical place at all. It is a computer system, called the Public Electronic Network (PEN), that residents may hook into, free of charge. PEN provides electronic access to city council agendas, staff reports, public safety tips, and the public

Santa Monicans can log on to the Public Electronic Network (PEN) from their personal computers or from public terminals such as this one at the city's main library. Although initially intended to improve access to city records and officials, PEN has become primarily a forum for free-wheeling discussion on a wide range of topics.

library's on-line catalog. It also allows residents to enter into electronic conferences on topics ranging from the political (discussions about rent control or human rights) to the utterly apolitical (such as TV's *Simpsons* or household pets). Santa Monicans can tap into PEN from a home or office computer or use one of the public terminals in libraries, community centers, and elderly housing complexes.

Each time a PEN user enters a comment, it immediately appears on the screen of other PEN users logged on to the same discussion item. As many as 64 people can use the system at once, so the comments can come thick and fast, just as if people were sitting around a room chatting. Sometimes the conversations are elongated—with a comment made one day and responses coming several days later. Discussions on a single topic may last for months. In addition to having access to these public conferences, each PEN user gets a private electronic mailbox for exchanging messages with city bureaucrats, politicians, and fellow citizens.

In a sense, Santa Monica is appropriating for public purposes technologies that had previously been mostly the province of businesses and individual computer devotees. Corporations use electronic mail to communicate with their customers and with one another. Private computer networks, such as CompuServe, allowing subscribers with common interests to meet without the traditional constraints of time and space. Using such a network, for example, a chess aficionado in Nebraska might strike up a friendship with a like-minded soul in London.

Applying these innovations to a public-sector network, a couple of visionary Santa Monicans thought, would give residents more direct access to their local government. The system could offer citizens a new way to be heard politically, free from the conventional gatekeepers in City Hall and the press. More broadly, it might prove a powerful antidote to the isolation and anomie of modern urban life by offering a new way for Santa Monicans to interact and forge alliances. This, in turn, might eventually involve more residents in civic affairs. "Engagement is what democracy is all about," says municipal court judge David Finkel, a member of the Santa Monica City Council in the late 1980s and



Ken Phillips, PEN's chief architect, originally conceived of the system as a way to allow city councillors to communicate by electronic mail.

an early fan of PEN. "The more people communicating on PEN, the more potential political activists there are to jump in and stir up the pot."

In its two and a half years of operation, PEN has had a tangible impact on Santa Monica. For instance, through PEN, a group of residents—including three or four homeless men—formed an on-line political organization that lobbied successfully for new city services for the homeless (see "Helping the Homeless," on p. 50). But PEN also has its detractors. Some dismiss the system as a high-tech toy, kept alive by a few computer enthusiasts with nothing better to do. And in fact, a relatively small group of Santa Monicans dominates the

conferences, which often degenerate into mean-spirited verbal duels. The system also suffers from the lack of participation by most local officials. Nevertheless, PEN is a brave experiment. After all, not many municipal governments would play a wild card that could shift the balance of local political power.

Pioneering PEN

A city of 96,000 tucked between Los Angeles and the Pacific Ocean, Santa Monica has a reputation for leftish politics. Heavily populated with "frumpies"—formerly radical upwardly mobile professionals—the city has elected '60s rebel leader Tom Hayden to the California State Assembly since 1982. The city has responded with unusual tolerance to its burgeoning population of homeless people; police refrain from rousting them from city parks, and every weekday afternoon a community group provides a free hot meal on the lawn in front of City Hall.

The city does have a contingent of moderates and conservatives, but nearly all of political Santa Monica embraces certain basic principles. Mark E. Kann, author of *Middle Class Radicalism in Santa Monica*, defines this ideology as a belief in "human-scale community, participatory democracy, and one-class society." Thus the city is well suited to pioneer a system like PEN.

The system's chief architect and champion is Ken Phillips, director of the Information Systems Department in Santa Monica City Hall. Phillips had already presided over the introduction of an electronic mail system at City Hall in 1984, allowing 600 of the city's 1,500 employees to communicate via computer. The seven city council members received laptop computers with which to send messages to city bureaucrats and to each other.

PAMELA VARLEY is a Boston-based journalist and case writer at Harvard University's Kennedy School of Government. She has written a case study of PEN for the Kennedy School's program on innovation in state and local government.

In October 1987, Phillips conducted a survey of local residents. To his surprise, it revealed enormous interest in a public computer network. The survey also showed that a third of the respondents already owned personal computers and that almost three-quarters of this group owned modems as well. Despite these numbers, the Santa Monica city manager was reluctant to ask the council for the hundreds of thousands of dollars in equipment necessary to launch an elaborate public computer network. Undaunt-

One of Phillips's early concerns in designing PEN had been the prospect of on-line obscenity or slander. Would the city be liable for comments that appeared on the system, the way a television station is for material it broadcasts? Or would the city be no more responsible for such communications than the telephone company? There was no suitable legal precedents. After some discussions, the city decided not to play the role of censor at all, unless a court declared a particular comment only a slanderous or obscene.

A related question was whether residents should be required to log on under their own names. One worry was that by using real names, PENnners might feel exposed and therefore less inclined to enter debates. The city opted for real names, however, in part to deter irresponsible or obscene comments.

Topics of PEN conferences range from the frivolous to the weighty; the level of discourse is sometimes tawdry and sometimes almost poetic. Following is a sampling of what Santa Monicans are saying to each other over the network:

that it was the choice of the women to attempt an illegal abortion, and if they died from it, tough luck. Right to life indeed.

Right to life should be forced to staff hospital wards.

Feminists are setting up (I suspect even more determined and avidly) underground networks to ensure "safe" abortions for women who desire them. As well, they are working on developing self-induced abortion techniques, etc. They are also developing contacts with sympathetic doctors willing to perform them despite sanctions.

There's not going to be any need for an "underground." Abortion will always be legal in enough states, with wide enough geographical distribution, such that all any woman will have to do will be to get to a neighboring state.



The Lure of Conferences

City planners had expected the heaviest use of PEN to come from residents seeking information from one of the city's databases. They were wrong. From the beginning, the public conferences were by far the most popular attraction, accounting for more than half the calls. Electronic mail was the second most popular feature, followed by access to city databases. One of the clearest lessons of PEN, according to William Dutton, a professor at the University of Southern California's Annenberg School for Communications, is that people do not crave new sources of information so much as new venues for talking to one another.

In fact, many PEN users report that when they first began logging onto the PEN conferences, they went through a period of addiction (PENaholism, some call it) and found themselves mesmerized for hours in front of the screen, night after night. Most addicts settled down after a few weeks or months, although a few continued to log on every day for several hours.

What makes PEN so seductive? "You start playing with electronic mail and then you start looking forward to logging on in the morning to see if you got any mail in return," explains Phillips. "And then you post a comment in a conference, and the the next time you log on, 15 people have said something about what you've said.

That's a heady brew."

Kevin McKeown, chair of the PEN Users Group, compares the system to a traditional New England town meeting—except that PEN is every day. "It's not like writing a letter to the editor of the local newspaper, where you have a chance in a thousand that it will be published, and no one ever responds to you even if it is," he says. "You put something provocative on PEN, and you get responses. And then other people chime in and pretty soon you've got a good debate going."

PEN also is casual and chatty, so a user does not need to measure every word. PEN offers housebound people a way to socialize. And it is always available: "PEN is the only place in town where I can have a decent conversation about a meaningful subject at a moment's notice," says one user.

Another draw for many users is the leveling effect of the PEN conferences. Judged solely on what they say on-line, people can easily cross social barriers. Homeless people talk to the well-to-do, teenagers talk to adults, political neophytes talk to City Hall's old hands. Even gender lines blur if a resident registers using only initials or an androgynous first name. "It's been a great equalizer," says Don Paschal, who was homeless until November 1990 and began using PEN while living on the street.

The leveling effect of PEN means that when PEN



JOANNE LEAVITT 04-JUL-91 18:19

Robert is talking about a privileged class... those who can afford a trip to another state and a few nights hotel accommodations. How about a single mother with a couple of little ones at home? How about a teenage girl who is afraid to tell her family? How about...

CLAUDIA KRIEGER 04-JUL-91 18:23

Glad you brought up those examples, Joanne. There are so many.

RICK SAVAGE 04-JUL-91 18:24

My guess is that this issue will get even more polarized after the fall of Roe vs Wade and that states that vote to keep abortion legal will also vote to make it affordable/free. Travelling to another state is relatively easy and cheap. In most parts of the country it only takes 1-2 tanks of gas.

CLAUDIA KRIEGER 04-JUL-91 18:27

Babysitting costs, loss of the

day(s) wages, overnight(s) stay, etc. . . .

JERRY NEWPORT 06-JUL-91 15:34

Stay tuned for the grand opening, on the Arizona-CA border, or maybe Nevada-CA: Gloria's Baby Motel (shaped like a big roach motel); "Fetuses check in, but they don't check out."

JOANNE LEAVITT 08-JUL-91 17:57

The Greater Los Angeles Coalition for Reproductive Freedom is holding a rally, Sunday, July 14th, 10:00 a.m. at the Westwood Federal Building. If you would like further information, need a ride or whatever, send me an e-mail for the appropriate phone numbers. Also needed are letters to both the President and our local papers regarding the Gag Rule (Rust v. Sullivan).

CLAUDIA KRIEGER 08-JUL-91 18:40

Will do, Joanne. . . Stormin' the Bastille!

RESPONSE TO A TRAGEDY

SUSAN DAVIDSON 01-SEP-91 8:17

James Burgess died Saturday after trying to flag down an RTD bus in West Hollywood. He accidentally lost his balance and fell under the wheels of the bus. If you have any information about his relatives, please call the sheriff's station at 855-8850. They do know that he was from Washington and living at a homeless shelter in S.M.

RICHARD GROSS 01-SEP-91 8:42

That is really sad and upsetting news. James had just started living in an apartment in the valley, and was in the process of finding a job.

ROBERT SEGELBAUM 01-SEP-91 12:30

Someone should sue RTD on his behalf. RTD drivers are, in general, utterly callous about passengers trying to board their buses once they decide to pull

users do finally meet face to face, there can be surprises. McKeown remembers his shock at finding that some of the most thoughtful comments on PEN were written by a precocious teenager. City council member Ken Genser remembers meeting a PEN user he had assumed to be an elderly curmudgeon only to find that he was 25, with a pony tail.

Trouble in Paradise

PEN's egalitarianism also makes the system vulnerable to abuse. PENners quickly discover that they must contend with people who feel entitled to hector mercilessly those with whom they disagree. It is, Phillips says, a little like trying to hold a meeting while "allowing somebody to stand in a corner and shout."

"Part of what makes PEN so volatile," says McKeown, "is that you're not face to face. There's not a chance you're going to get popped in the chops for what you say, so you feel like you can get away with more. In a way, that's liberating. But then you have the occasional 'flamer,' as they're called in on-line circles, who doesn't care if he or she hurts people."

As active PEN user Robert Segelbaum puts it, com-

"PEN is the only place in town where I can have a decent conversation about a meaningful subject at a moment's notice," says one PEN user.

puter conferencing turns writing into "a performing art." Michele Wittig, a psychology professor at California State University at Northridge and an active PENner, contends that "public postings take on the character of ripostes because, like fencing, PENning often occurs between two or three people interacting before an audience."

When the system started up, women—greatly outnumbered by men—had problems with harass-

ment. "Several men would badger us a lot when we came onto the system," Wittig says. "We'd started on-line discussions about sexism and equality of women in the workplace. They made disparaging remarks and innuendos." Even worse, she says, "several of the 17- and 18-year-olds started to post their very violent fantasies. They would use initials of women on PEN and say that they would dismember us and rape us." By the summer of 1989, the few women on line were fed up and ready to drop out.

Another kind of problem comes up when one or two PENners "go off thread," straying from the conference topic into a personal reverie or chitchat that all participants must wade through. PEN etiquette allows

out. They seem to take some sort of sadistic pride in making people wait for the next bus when it would cost them no more than 5 seconds of their time to pause and open the door. I am quite certain that this horrible incident came as a DIRECT RESULT of such callousness.

MARGARET WILLIAMS 01-SEP-91 15:54
There should be an inquiry. I've seen RTD drivers close doors in people's faces after they've sat and watched them run to try to catch them in time. James was deaf. It is appalling to think of him (or anyone) dying this way.

FRANCEYE SMITH 01-SEP-91 16:01
A few years ago when my boss went to China, he showed us pictures of the tour bus they took. This bus had a closed-circuit TV camera at the back with the screen in front so the driver would see anyone in the road behind him. Our buses need some-

thing like this—or better rear-view mirrors. No one should ever die under the wheels of a bus!

RICHARD GROSSMAN 02-SEP-91 21:46
Has anyone found out anything about James's family?

DONALD PASCHAL 03-SEP-91 12:32
re the Late Mr. Burgess: He was deaf, gay, and a human being, in reverse order. He simple asked people to get to know him. I wish I did. Rest in peace, Mr. Burgess.

THE HOMELESS

BILL MYERS 21-AUG-91 10:07
Is there a reason for our city not to allow the homeless shelter at night when public facilities are locked until morning? City Hall itself could be open to the public at night for such a service, no? Naturally, there would be "problems" to iron out, but this

shouldn't be too difficult with a few good minds at work. Other cities could follow our lead, too, which might force public officials to take a more serious look at homelessness. And this might prove to speed up this slow process of actually ending homelessness.

DONALD PASCHAL 21-AUG-91 10:13
Where EXACTLY in City Hall. . . I'm sitting in the place right now, and I can't see, based on the layout of the place, how that can be feasible. You have to have some sort of security, a way to control bathroom flow, and how are you going to accommodate 1000 people inside city hall? Good suggestion, wrong building.

SUSAN DAVIDSON 21-AUG-91 10:22
How about the Auditorium?

DONALD PASCHAL 21-AUG-91 10:26
Again, where. . . on stage. . . and

how do you accommodate for events. . . let's say Guns'n'Roses were playing at the Auditorium. . . can you imagine telling Axl Rose he has to cut his set short because a bunch of homeless people were waiting to sleep on the stage?

SUSAN DAVIDSON 21-AUG-91 10:28
How often is that white elephant used, anyway?

DONALD PASCHAL 21-AUG-91 10:29
Enough to know that (a) it would not be practical and (b) anyone suggesting that would be laughed out of council chambers.

SUSAN DAVIDSON 21-AUG-91 10:33
Well then it's worth a try!

THE SOVIET BREAKUP

DONALD PASCHAL 25-AUG-91 16:18
Remember. . . Communism itself is not dead. . . only the party in

everyone to discuss any topic and express any opinion, no matter how arcane. But instead of interrupting discussion, a PENner who wants to change the subject is expected to open a new conference item. Some PEN users, for instance, enjoy chatting on-line about their stuffed animals. That's fine, McKeown says, provided they confine their ruminations to a special "stuffed animals" conference item.

PEN occasionally suffers as well from the tyranny of those with too much time on their hands. In a few cases, PENners have been known to comment not only on every topic but on virtually every *comment* made on every topic. Since thousands of comments are entered in PEN, this metacommentary can be oppressive, especially if the PENner is ill-mannered and given to name-calling. "There are people who have dominated on-line discussions for months now," says McKeown. "And there's no way to shut them up." Most PEN devotees cringe at the antics of the system's resident bullies because—aside from the immediate unpleasantness they produce—these troublemakers tend to reduce the forum's apparent importance in the eyes of the general public. "Sometimes it degenerates into nothing better than one of those \$5-a-minute telephone lines," says one regular user.

Of course, just about any public forum has a similar problem. At every Santa Monica City Council meet-

ing, for instance, one woman gets up to speak on each item on the agenda—prolonging meetings by as much as an hour. "Any system can be abused," McKeown says. "What you have to look at is the balance—how many people are you enabling and empowering and how many people are going to abuse that kind of power?"

PENners have come up with a number of ways to cope with on-line bullying. In response to harassment, for example, the women on PEN banded together in July 1989 to form a support group called PEN Femmes. The group makes a point of welcoming women when they begin to participate in PEN conferences. Harassment has subsided as more women have become active. The city has also made available private conferences, so that groups of like-minded people can work on a project in peace—an idea Phillips likens to allowing a community group to meet in a private room at City Hall.

E-mail, too, has proved useful against PEN abuse. For one thing, if two PEN users get off track in a conference—suddenly realizing that they want to chat about football, say, instead of property assessments—they can do so privately. E-mail is also a good way to let someone know he or she is breaching PEN's etiquette without dressing the person down in public. "One of the worst things you can do," McKeown says. "is respond to a blowhard on-line, because he'll blow hard



the USSR. What form Communism takes is what the administration is watching.

BRIAN HUTCHINGS 25-AUG-91 16:21
I mean, both Bush & Gorbachev have ties to the bad-assed sides of their respective intelligence agencies (Gorby having been hand-picked by mister Andropov.)

DONALD PASCHAL 25-AUG-91 16:39
A good point, but what of Yeltsin.

sin. He seems to be going headstrong in trying to eliminate Communism altogether. . . and he is very popular. Plus remember, both are politicians in the new (TV-oriented) school, something only one other Soviet leader seemed to be. . . .Nikita Krushchev.

SUSAN DAVIDSON 25-AUG-91 19:05
Nick was a tad heavy handed, tho.

CURTIS SHENTON 25-AUG-91 20:36
Anyone watch *60 Minutes* tonight? It had an interesting piece by a Soviet reporter that brought to light the fact that the majority of Soviets didn't oppose the coup. Not that they supported it, but many, if not most, of the Soviet peoples feel that democracy and perestroika have ruined the country.

THOMAS LEAVITT 25-AUG-91 21:55
Hmm. . . Ukraine declared itself independent, Russia is going around recognizing the Baltic states as independent, various

and sundry republics and autonomous regions are squawking. . . question will eventually be faced. . . why the defense establishment? Is that the reason Bushie baby is busy trying to support Gorby to the max?

DANIEL BRIN 25-AUG-91 23:57
Am I the only person who is appalled that Yeltsin unilaterally shut down the Communist Party's newspapers? Is this the action of a democrat?

PHILLIP CARTER 26-AUG-91 9:39
Actually, the Communist newspapers, i.e. Pravda, Red Star, were state run, censored, and full of false news and propaganda. They were not newspapers in any true sense of the word, so I don't see why we should be appalled at all.

DAVID MORGAN 26-AUG-91 15:43
The *60 Minutes* show was quite interesting. Yeltsin is not popular among the workers, and the Moscow reporter thinks they have a year, at most, to make

democracy work. Most of the people interviewed thought things were much better under communism. I guess because there was food in the stores, and they had jobs.

WHERE ARE THE POLITICIANS?

WILLIAM NOBLE 12-JUL-90 23:34
How come [Tom] Hayden isn't on PEN anyway. Let's all write him nasty letters saying that we won't vote for someone who can't take the time to listen to us directly (through staff even)

JOANNE LEAVITT 13-JUL-90 0:42
Seems to be a problem with the way the equipment is set up. The ones tied into Sacramento are on dedicated lines. Can't use them for both. Still don't understand, but something like this is the problem.

ROBERT SEGELBAUM 13-JUL-90 10:11
Joanne, there is absolutely NO technical problem with someone signing on from Sacramento or anywhere else on earth.

right back at you, in an endless cycle." Sometimes, when approached by e-mail, a PENner can be persuaded to delete an offending comment from a conference, or at least to temper his or her future comments. Says Phillips, "The ability to operate behind the scenes with e-mail is the glue that keeps the conferences running."

Coping with a Hard Core

PEN's biggest disappointment has been the domination of its conference discussions by a small number of users. More than 3,000 people are signed up for PEN, but only 500 to 600 log on each month and most never add any comments to the conference discussions. PENners talk about the "50 hardcore" users whose names appear again and again. While the average PEN user logs on to the system about 12 times a month, some PENners do so 8 or 10 times a day.

Most of the hard-core PENners tend to be pro-rent control, antidevelopment, and sympathetic to the plight of the homeless. But according to city council member Genser, the core users differ from other community activists in town. The PEN group is "less of an insider crowd," he says. They tend to approach government

*PENners
pounce on any officeholder bold enough to enter the on-line fray, making accusations and demanding a response.*

with a "wide-eyed innocence."

Those active in the conference discussions tend to be articulate; they also tend to be thick-skinned and to enjoy verbal skirmishes. Says active PENner Bill Myers, "The attacks have been quite vicious at times, creating a kind of survivalist attitude among PENners. It is like an electronic pack of wolves who gather together for strength and companionship."

Santa Monica's political movers and shakers have, for the most part, stayed clear of PEN's crucible. If the active PENners are, as Myers suggests, an electronic wolf pack, then a politician on PEN becomes a computerized rawhide bone. PENners tend to pounce on any officeholder bold enough to enter the on-line fray, making accusations and demanding a response. Politicians are accustomed to guarding their public comments closely, working out their positions ahead of time with core constituents and then "going into meetings with relatively fixed positions," says judge and former council member Finkel. But politicians who "think out loud" on PEN and respond conversationally to questions subject themselves to intense scrutiny.

Most PEN users, says Katz, are "fringe" types, like

JON STEVENS 13-JUL-90 12:03

What I don't understand is why we don't have more political participation on PEN from public officials? Our city seems to be behind pen but for some reason we can't even get local media to open up a conference to hear from their audience. As for getting Tom Hayden online, William, some of us feel he would be the perfect politician to use this system to promote grass roots participation in the electoral process. I have been accused of driving people off PEN because of some of my confrontive and adversarial responses online. I have told the misguided souls in no uncertain terms that they need to have a good bowel movement and to do to themselves what only certain species of worms and slugs have the anatomical capacity to accomplish. I cannot take credit for driving people off PEN and in fact have been trying very hard for over a year to do just the opposite. Forgive me for being persistent and impatient.

WHAT SANTA MONICA NEEDS

PHILLIP CARTER 05-MAR-91 21:30

I think that the city needs to promote bicycling more by establishing more safe routes and paths along Santa Monica streets. Our city is a very environmentally conscious city, and cycling to work or school is one way to cut down on pollution. I'm not sure how many people on PEN use bicycles as transportation. I do because I don't drive yet.

WILLIAM NOBLE 05-MAR-91 22:21
specific building codes designed for gray water irrigation.

BILL MYERS 06-MAR-91 01:15

I think our city would make a move in the right direction by creating another task force regarding methods of conservation and ideas promoting our more informed and new age society.

ROBERT SEGELBAUM 06-MAR-91 9:29
One thing this city desperately

needs is housing for low- and middle-income people and one thing it absolutely does NOT need is more office space.

JERRY NEWPORT 06-MAR-91 15:28

The best way to provide affordable housing here is to allow rental of rooms in single homes, and allow landlords to charge higher rents to those who can afford them, with a controlled pass-through of a fair portion of that profit to subsidize affordable units.

WILLIAM HANDELSMAN 06-MAR-91 15:35

As an aside, the Coroner-select for LA recently turned down the job because even with a loan for 30% from the County a comparable house of 5000 sq.ft. like he has in Pittsburgh would cost at least \$1,000,000 in LA.

PHILLIP CARTER 18 MAR 91 18:51

Our city needs to revitalize its streets to hold water. Up in Seattle, where it rains a lot, their streets can handle the water. Here, when it rains, the next day

the roads really suck. On a bike you notice this. Also, our roads aren't designed to absorb the runoff of oils, paints, and other chemicals onto the street which in turn make it slippery. As well, the sewer system that collects street water is not adequate. Though we are at a budget premium, how much extra would it take the next time S.M. redoes its roads to make them watersafe.

GERALDINE MOYLE 18-MAR-91 18:53

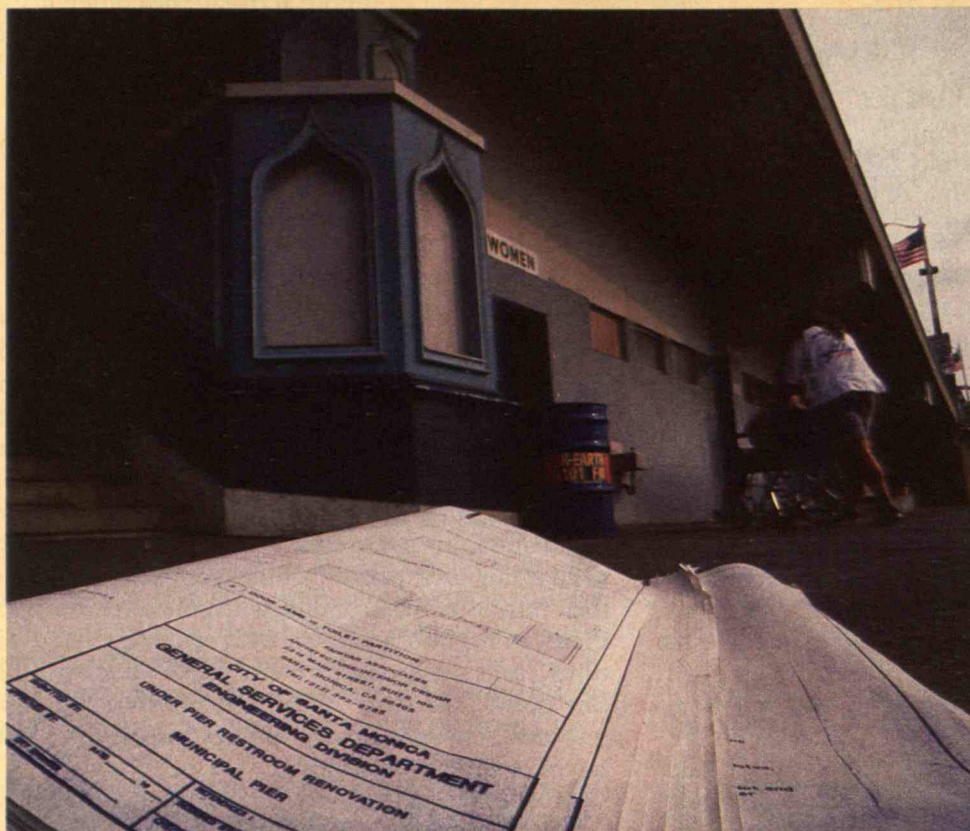
Phillip: there is no sewer system to collect waste from the streets. Water, and everything else spilled on the streets, flows down into storm drains, which, although they have catchment basins for solid trash, essentially carry rain-water etc. into the ocean.

JACK KOLB 18-MAR-91 19:01

An ocean which has been smelling unctuous all day. ■

Helping the Homeless

DESPITE the lack of participation by Santa Monica's political leaders, PEN has been instrumental in forming one civic project: an effort to provide better services for the homeless. The initiative began with on-line discussions of homelessness in the winter and spring of 1989, a time when surveys showed that this issue was the number-one local concern of Santa Monica residents. Several homeless men took part in the discussion using public terminals at a city library. As participants read their stories and comments, says Kevin McKeown, who chairs the PEN Users Group, they began to realize that not all



the people who call in to radio talk shows. "They're both liberal and conservative, but way over, one way or another, on an issue," he says. Chris Reed, a council member who has participated in the conferences, agrees. She characterizes PEN's hard core as "mean-spirited people who pound out their anger on the keyboard. They've poisoned the system and driven off the reasonable people." Reed quit PEN in August 1990, announcing that she was fed up with being attacked. "If people had been the least bit polite, or respectful of the need for people in a democracy to differ," she says, "I would have stuck it out."

Reed was not the only local politician to give up on PEN in exasperation. When city council member Judy Abdo, who had been active on PEN during its first year, diverged from her liberal council colleagues by supporting a local beachfront hotel development, she too incurred the wrath of PEN regulars. After battling it out on-line for a while, she stopped participating.

Another reason that politicians shun PEN is their perception that the network is a time sink. A few months after the system started, Santa Monica's congressman, Mel Levine, agreed to sponsor several on-line discussions about national and international policy. Levine's district office staff monitored the conferences and, when ques-

tions arose, either answered them or (more often) sent them to Washington for research and reply.

Yet this arrangement has not satisfied anyone. PEN users resent that it takes several weeks to get their questions answered and that Levine does not enter the debates personally. Levine's staff, meanwhile, is frustrated at having to do a great deal of work to respond to the demands of a small number of constituents—and then being lambasted for failing to do more. "We take a beating on a system we volunteered to participate in," says Blaise Antin, staff assistant and PEN coordinator in the congressman's district office. Even Santa Monica's guru of participatory democracy, State Assemblyman Tom Hayden, insists that he and his staff don't have time for PEN.

Phillips believes that much of the problem could have been averted if PEN had started up a little differently: "I recommend to people that if they're going to do a system like this, they start with a group of community leaders, and let them set the tone of the system."

Breaking New Ground

Some PENners argue that it's too early to conclude much of anything about the experiment, which, they

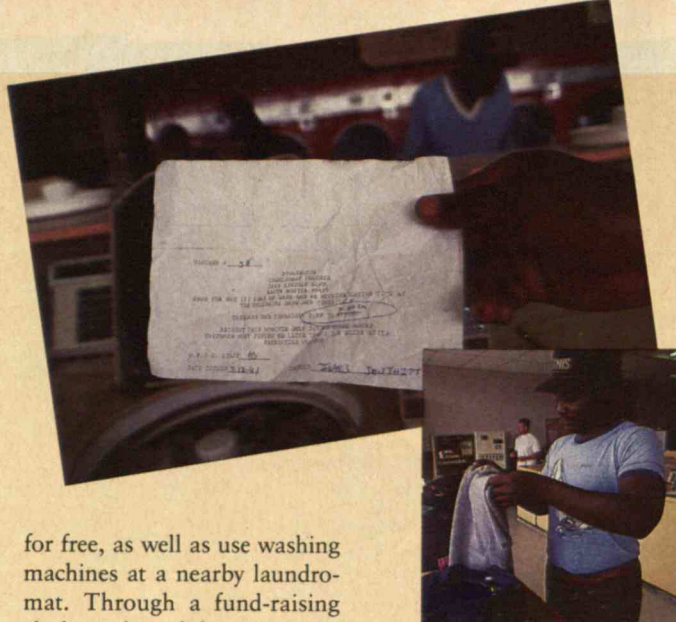
the homeless were mentally ill or drug-addicted. "There's a significant percentage who are involuntarily homeless because of something that happened. How many people, if they missed two or three pay checks, couldn't make the rent?"

In July 1989, as a result of a proposal by Michele Wittig, a psychology professor [at California State University at Northridge] and PEN enthusiast, PEN users formed a group to work on community projects and made homelessness its first agenda item. One PENner proposed that



what homeless people really needed to seek employment was early morning showers, a place to wash their clothes, and a locker in which to store their belongings. That was the beginning of a project dubbed "SHWASH-LOCK" (for SHowers, WASHers, and LOCKers).

The PEN Action Group, about 20 people in all, took stock of the community's existing resources and came up with a proposal for a facility near the beach with showers and lockers. There were some stumbling blocks along the way—neighborhood resistance to one proposed site for the facility, for instance. But the action group persevered and in May 1990 brought its proposal to the City Council, which has since approved it. The PEN Action Group has worked with social service groups to provide homeless people with vouchers so they can use the showers and lockers



for free, as well as use washing machines at a nearby laundromat. Through a fund-raising clothes sale and donations, the group raised more than \$4,000 for this effort.

Acting on the suggestions of Don Paschal (a homeless man who participates in PEN), the group has begun work on another way to help the homeless: an on-line job bank that will be run as a cooperative venture with local social service and business groups.—Pamela Varley ■

Thanks to a group formed on PEN by Michele Wittig (left), beach restrooms are being renovated to allow homeless people to take early-morning showers and store their belongings in lockers. Above: A homeless man uses a laundromat, "paying" with a free voucher.

point out, is still in its infancy. "It's going through growing pains," says Finkel, and despite its shortcomings, he still believes it to be a "wonderful new First Amendment tool."

McKeown agrees. "I see PEN as a way to change the whole political process, the whole exchange of information with voters, the whole way that we interact with our city government," he says. "Five or ten years down the road, we're going to have candidates for City Council and other positions that will run only because they got involved through PEN."


Gary Orren, a professor of public policy at Harvard University and co-author of *The Electronic Commonwealth*, is less sanguine about the prospects. New communication technologies tend to acquire a following of true believers who have utopian notions of what they will accomplish, he says. Orren believes there will never be more than "a very small subgroup of unusual people" who take part in computer conferencing that requires typing on a keyboard and reading from a screen. An audiovisual communication medium will be more likely to attract users, he believes. But even a more sophisticated interface may ultimately prove futile. The sad truth, he says, is that "people have a limited and declining taste and hunger for politics."

And in fact, other U.S. communities have yet to copy PEN. More than 100 other municipalities are experimenting with public computer networks. But in most cases, that simply means that a resident can approach a multimedia kiosk—say, in a shopping mall—and, after viewing a videotaped message from the mayor, dial up the city computer for land-use records. Most local governments, gasping and struggling financially, are not inclined to risk a sizable chunk of their budget on something that may be branded a frill. No one else has created a system as interactive as PEN or as socially ambitious.

Nevertheless, PEN has broken important new ground, and it may yet inspire future efforts. What is unusual and exciting about PEN, says Jerry Mechling, director of strategic computing and telecommunications at Harvard's Kennedy School of Government, is that a public-sector entity is doing something that is normally done only by the private sector—namely, using technology not merely to automate an existing method of doing business but to "rethink the basic way things are done." With PEN, he says, Santa Monica is "using technology to explore different ways of reaching the public. If we encourage many such experiments, I'm optimistic that we'll find better ways of doing things." ■

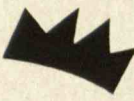


A Weapon Without a Purpose



The United States didn't need an antiballistic missile system in the past.

Existing technology eliminates any need for one now.



DURING the 1967 international Pugwash conference in Sweden of scientists working to avoid nuclear war, members of the U.S. delegation tried to convince their Soviet counterparts that defenses against nuclear-tipped ballistic missiles were not only unworkable but also dangerous. The American scientists argued that because each nation would want to maintain the credibility of its nuclear deterrent, improved defenses would simply breed more offensive weapons in an endlessly ascending spiral. Each nation would add to its offensive arsenal to ensure its ability to overwhelm the other's defenses.

The chief Soviet delegate, Mikhail Millionshchikov, was unconvinced. A world-renowned physicist, he insisted that such defenses were attractive both intellectually and politically. Not only do they indicate no aggressive intention, he said, but they also are popular because they are meant to protect civilians from nuclear incineration. A year later, in Glassboro, N.J., the scene was repeated when Soviet Premier Alexei Kosygin resisted the arguments of President Lyndon Johnson and Secretary of Defense Robert McNamara for limiting the development of antiballistic missile (ABM) systems. By then, Soviet scientists had adopted the logic of their U.S. colleagues but had yet to persuade their political leaders.

Eventually, the Soviet hierarchy realized that ballistic-missile defenses were costly, technically infeasible, and a root cause

of the nuclear arms race. On May 26, 1972, Richard Nixon and Leonid Brezhnev signed the ABM Treaty, which banned both countries from implementing nationwide ballistic missile defenses. Review conferences in 1982 and 1987 have reaffirmed the treaty.

Yet the political attractiveness of ballistic missile defenses continues undiminished in this country. Some U.S. conservatives still dream of a perfect defense that would let the United States destroy its adversaries with impunity, and they resent the loss of sovereignty that the prevailing doctrine of nuclear deterrence implies. This doctrine makes the security of the United States dependent on the good sense and realism of Soviet leaders, whose fear of certain U.S. retaliation would deter them from attacking the United States. The general public, meanwhile, filled with notions of the omnipotence of this nation's technology, would like to believe that American ingenuity could protect them from any threat—nuclear holocaust included. Apparently, Americans still yearn for the insular security the country enjoyed before the advent of nuclear explosives and ballistic missiles. The problem with such concepts of national security is that they have been, and remain, impossible.

That there is no rational reason to pursue ballistic-missile defenses is illustrated by the fact that ABM advocates have summoned up a non-event—the performance of the Patriot ground-based antiballistic missiles against Iraqi Scuds—to bolster their position. In his 1991 State of the Union message, President Bush, citing the “success” of the Patriots, called for support for a refocused Star Wars program “to provide protection from limited ballistic-missile strikes whatever their source.” In February, Sen. Malcolm Wallop (R-Wyo.) wrote a *New York Times* op-ed piece (“Patriots’ Point the Way”) in which he advocated, as he has in the past, abrogating the ABM Treaty and proceeding full speed ahead in developing and deploying Star Wars. Meanwhile, congressional opponents of space-based defenses, including Rep. Les Aspin (D-Wisc.), are using the Scud threat to push for ground-based ABMs and derail the deployment of Star Wars’ space-based systems.

How did the Patriots perform? Despite the well-publicized fireworks over Tel Aviv and Riyadh, it is difficult to say definitively. The damage Scud missiles visited upon Israel was not demonstrably different before and after Patriots were installed there. This could

mean the Patriot is ineffective against terrorizing attacks on cities, but another interpretation is more appropriate. Because Iraq unsuccessfully modified the Scuds, most of these missiles disintegrated upon reentering the atmosphere. As a result, there were few if any intact Scuds for Patriots to hit, so the performance of the Patriots was not actually tested. At best, then, their performance is unknown. This is hardly cause for optimism regarding the performance of ground-based ABM systems and even less a reason to invest heavily in them.

If the Gulf War provides a lesson, it is the success of cruise missiles. A future stealthy cruise missile could carry half a ton of high explosives, essentially unobserved, with almost perfect accuracy, over hundreds of miles. This kind of weapon would be relatively easy for a nation such as Iraq to develop or purchase and would be a genuine military threat to U.S. bases abroad. The United States should be pursuing battlefield anti-aircraft defenses against such weapons, not ABM systems.

In fact, for the foreseeable future, the United States faces only one credible threat that an ABM system might conceivably counter: an accidental or unauthorized nuclear attack from the Soviet Union, China, or, in the more distant future, emerging nuclear nations. But to counter even this threat, there exists a far simpler and better answer than an ABM system, both technically and politically: a self-disarming mechanism, installed on the nuclear warheads of all ballistic missiles, that could be instructed via radio to incapacitate the weapons and prevent unwanted nuclear detonations.

A System in Search of a Mission

The United States began searching for a way to shoot down ballistic missiles in the late 1950s after Sputnik showed that the Soviet Union could apparently deliver thermonuclear weapons across intercontinental distances. But while the U.S. ABM system went through several incarnations, none could protect civilians from nuclear attack. First came the Nike-Zeus, a land-based system consisting of two types of nuclear-tipped missiles and radars that could track a few targets at a time. This was followed by the somewhat more sophisticated Nike-X, with phased-array radars that could engage many incoming warheads at once, and armed with the swifter Sprint and Spartan missiles, the first with a range of 10 to 20 miles, the second with a range of 300 miles. All these systems—indeed, all ground-based ABM systems intended to protect cities—shared two fatal flaws. First, they were terribly unpopular because defending cities meant deploying nuclear missiles in their suburbs; the Sprint missiles, for example, were nuclear-tipped.

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Second, nuclear detonations above or in the atmosphere would blind their radars. In fact, a nuclear-tipped defensive missile system would blind itself in the first few seconds of an engagement.

Nevertheless, under political pressure from the right to pursue missile defenses, in September 1967 the Johnson administration announced its intention to develop the Sentinel, a thin ABM system designed to counter the lesser Chinese threat. When that system fell victim to public opposition, the Nixon administration renamed it Safeguard and changed its mission to protecting Minuteman missile silos—but without altering it technically. Indeed, one Safeguard site was completed in North Dakota in 1975, but it was immediately shut down because the limited protection it offered to the silos wasn't worth its high cost: \$600 million in 1973 and \$340 million the following year.

Undaunted by the deactivation of the Safeguard site, in 1978 ABM enthusiasts attempted to advance an ABM system called LoADS (Low Altitude Defense System), this time to protect MX missiles that would be shuttling among 24 shelters arranged around a racetrack-shaped roadway planned for the deserts of Utah and Nevada. When the people of these states, with support from Nevada's usually pro-military Republican Senator Paul Laxalt, rejected this multiple-shelter basing mode, ABM advocates realized that ground-based ABM systems would probably never garner the necessary congressional support. While the Pentagon's budget soared in the first years of the Reagan administration, funding for the defensive systems remained low.

Space was the obvious alternative for basing antiballistic-missile defenses. First, Sen. Wallop championed space-based lasers, but the Pentagon's Defense Science Board rejected the idea in 1981. Next, in 1982, came "High Frontier," a proposal to orbit thousands of rockets that could be fired against Soviet ballistic missiles outside the atmosphere. When an Air Force study found that idea technically flawed, it too quickly dissolved as a serious option. As John Gardiner, the Pentagon's director of defensive systems, told the Senate Armed Services Committee in 1983, "The entire High Frontier proposal is technically unsound. It suffices to mention that it requires the kill rockets that attack the Soviet ICBM to be fired against it 50 seconds before



NON-THREAT #1:

*A current
nuclear power could
deliberately launch
a nuclear attack.*

the target ICBM was launched."

Within months, however, on March 23, 1983, President Reagan proposed his "Star Wars" program to render nuclear-tipped ballistic missiles "impotent and obsolete," thereby protecting the nation from Soviet nuclear weapons

"just as a roof protects a family from rain." Politically and psychologically, it was ingenious. As documents of that period indicate, the proposal was intended to co-opt the anti-nuclear message of the arms-control community and assuage the fears of nuclear war that had prompted over half a million people to demonstrate against the Reagan administration nine months earlier in New York City. Moreover, its exotic, space-borne character appealed

to the science-fiction-fed younger generation, while some voters were heartened to see the government summon U.S. technological ingenuity to protect them from the Soviet nuclear threat. Finally, Star Wars countered the sense of interdependence with the Soviet Union that mutual assured destruction and nuclear deterrence imposed on the United States.

The trouble was that Star Wars I, Reagan's original proposal, couldn't work and was unfathomably expensive. Two years before the president's speech, technical studies performed by the MIT Program in Science and Technology for International Security had shown that the laws of nature make space-based population defenses impossible. Laser and neutral-particle beams would lack the necessary lethality to destroy rising ICBMs many hundreds of miles away, and inexpensive countermeasures could blunt their effectiveness. Study after study since then has reached the same conclusion: it is impossible to protect civilians against an opponent like the Soviet Union. Even the most sophisticated Star Wars defenses would be vulnerable to countermeasures that could be implemented at one-tenth the cost of the system itself.

History began repeating itself. Once it became clear that protecting cities was impossible, the Strategic Defense Initiative Organization (SDIO), the Pentagon agency created to run the Star Wars project, shifted ground. Star Wars II directed essentially the same technology to protecting missile silos, thereby supposedly enhancing deterrence, an admission that the pre-Reagan

doctrine of mutual assured destruction was still the only viable way to protect the United States from nuclear attack.

However, the end of the Cold War has left even Star Wars II lacking a credible mission, as the probability of a deliberate nuclear attack against the United States by the Soviet Union or China is dwindling to that of attack by France or England. Thus SDIO has once again shifted the mission and name of the system originally proposed meant to protect cities. The new name is "Global Protection Against Limited Strikes" (GPALS), a space-based system that SDIO claims can deal with some post-Cold War threats but *not* with most short-range ballistic missiles like the Scud.

The events of the Gulf War added a politically resonant mission for ballistic-missile defenses. But does the threat from short-range tactical ballistic missiles, or any other threat for that matter, make an ABM system militarily relevant?

Post-Cold War Threats

For at least the decade ahead, the United States might conceivably face any of five ballistic-missile threats.

- A current nuclear power could deliberately launch a nuclear attack.

- A near-nuclear nation—for example, India, Pakistan, or South Africa—could acquire both nuclear warheads and the long-range ballistic missiles to deliver them and launch a deliberate nuclear attack.

- A terrorist group might acquire one or more nuclear explosives and use them against a U.S. city.

- An enemy might launch tactical ballistic missiles such as the Iraqi Scuds, either with nuclear or conventional warheads, against U.S. military bases or forces overseas.

- An unauthorized or accidental nuclear attack might emanate from the Soviet Union, China, or any other nuclear nation with ballistic missiles.

To begin with, not only is a deliberate Soviet or Chinese attack highly improbable now that the Cold War has ended, but the United States already has the proven means to prevent it. Deterrence worked through the darkest days of the Cold War; it will continue to work in the future. That implies the need for the United



NON-THREAT #2:

*A near-nuclear nation
could acquire both nuclear
warheads and the missiles to
deliver them and launch a
deliberate nuclear attack.*

States to retain a secure retaliatory force of a few hundred nuclear weapons, but at the same time it obviates any need for ballistic-missile defenses.

What's more, as the United States and the Soviet Union reduce their arsenals of multi-warhead land-based missiles, the need to enhance deterrence with an ABM defense for missile silos evaporates.

The same deterring mechanism that has kept Soviet and Chinese communists at bay can restrain newcomers to the nuclear club. No political leader would invite the obliteration of his or her country by attempting to destroy a U.S. city. Self-preservation and self-interest, the sturdy underpinnings of deterrence, are concerns that no national leader can ignore.

Still, Iraq's use of Scud missiles against Saudi Arabia and Israel has prompted some to assert that deterrence may not always dissuade new nuclear powers. For example, Rep. Aspin observed in April that "Saddam Hussein wasn't deterred. He faced virtual destruction of his nation, yet he still used ballistic missiles against U.S. forces and our friends." The flaw in this argument is that deterrence applies only to weapons of mass destruction, not to conventional weapons, whether delivered by plane or missile. Directing a Scud against Tel Aviv to provoke Israel into war has little in common with a nuclear-armed missile aimed at New York—the threat we are concerned with here—or even Tel Aviv. In fact, Saddam Hussein *was* deterred from using weapons of mass destruction. Although Iraq possesses chemical weapons, the assurance of retaliation in kind apparently stopped it from wielding them either against U.S. troops in the battlefield or our allies' urban centers in the region.

An ABM system, no matter how effective, can't counter the third threat, a terrorist nuclear attack, because the nuclear weapons wouldn't be delivered by a ballistic missile. A terrorist group that procured or manufactured a nuclear explosive would attempt to carry it clandestinely into the United States by means—such as boat, plane, or truck—that no antiballistic missile could intercept. Furthermore, even if a stateless terrorist group had a ballistic missile, it would be highly unlikely to use it against the United States because the attack could be traced to the country of launch, which then

would face nuclear retaliation. Deterrence would apply in this case as well.

We come to the fourth threat—tactical short-range ballistic missiles with ranges up to 1,000 kilometers wielded against U.S. allies around the world or U.S. military forces abroad. This is a two-part question because the threat from such missiles carrying conventional warheads is fundamentally different from that of nuclear-tipped missiles.

Tactical ballistic missiles with conventional warheads are not accurate enough to be militarily significant. Even with sophisticated and expensive guidance systems, a tactical ballistic missile with a 1,000 kilometer range can only come within 60 to 100 meters of a target. Even armed with a half-ton of high explosives, such a weapon has little probability of destroying a bridge, communications center, runway, or aircraft shelter.

Still, conventionally armed missiles are effective “terror weapons” when aimed at cities. From the German V-2 missile attacks on London in World War II to the missiles used in the Iran-Iraq war and the Gulf War, these weapons have terrorized civilians. Partially effective ground-based defenses against such attacks may become more feasible as the technology advances. But since this type of attack can’t reach the United States, should U.S. taxpayers pay for protecting allied cities from it?

A tactical ballistic missile with a nuclear warhead could destroy military targets such as airfields or communications and transportation nodes, but the 1987 INF Treaty between the United States and the Soviet Union has banned such intermediate-range nuclear weapons from the arsenals of the two nations. And although new nuclear countries could develop these weapons, it is doubtful they would use them against U.S. forces, given the ability of the United States to respond devastatingly.

In any case, defenses against nuclear tactical ballistic missiles would be technically difficult. Ground-based defenses would face the same problem that defeated the ABM systems of the 1960s and 1970s: a nuclear detonation preceding the main attack could blind their radars. And GPALS’ reach isn’t low enough to knock out tactical ballistic missiles, which barely leave the atmosphere. SDIO director Henry Cooper has



NON-THREAT #3:

A terrorist group

might acquire one or more

nuclear explosives and

use them against a

U.S. city.

testified that the system’s “brilliant pebbles”—orbiting self-contained missiles that would detect and attack ballistic missiles on their own—couldn’t hit missiles at altitudes below 100 kilometers.

One can conclude that the United States needs no further defense against tactical ballistic missiles: conventional warheads aren’t a significant military threat; nuclear warheads, if ever built, wouldn’t be used against U.S. forces abroad for fear of retaliation. Thus to invoke the threat from such missiles as justification for pouring money into theater defenses is simply irrational.

The Accident Threat

That brings us to the last threat, and the one that merits the most careful consideration. Even after successful negotiations to reduce their strategic nuclear arsenals, both the United States and the Soviet Union will each retain between 6,000 and 9,000 in-

tercontinental nuclear weapons through the end of the century and perhaps beyond; 4,900 of them on either side will be ballistic-missile warheads. Even if negotiations lead to further reductions, it is doubtful that either nation will reduce its arsenal to under 1,000 warheads in the foreseeable future.

Yet even as the number of nuclear weapons and the probability of their deliberate use declines, the risk of either an accidental or an unauthorized launch of strategic missiles remains. In an accident, a launch crew is convinced it has a valid order to act when in fact none has been issued. A missile launch is unauthorized if the crew acts without a command from the proper national authorities.

These two scenarios demand proportionately more attention as the prospects of a deliberate nuclear exchange diminish. Bomber-delivered nuclear weapons can be recalled or intercepted hours after their dispatch, but neither ballistic missiles nor long-range nuclear cruise missiles are recallable. Remote though it may be, the possibility of an unsanctioned launch of one or more nuclear delivery vehicles is real and presents the only danger of a nuclear attack on the United States.

The probability of a peacetime accidental launch of a U.S. or Soviet land-based missile is very small, but it can increase somewhat during practice exercises. And during a deepening crisis, when controls are relaxed

and launch crews are under enormous stress, an accidental launch of one or more such weapons is not unthinkable.

An accidental ballistic-missile launch from a submarine is even more probable, whether during peacetime or a crisis. This is primarily because central authorities have no physical control over submarine-launched ballistic missiles. The probability that an entire submarine crew could misinterpret a message as an authorization to launch its missiles is, no doubt, minute during peacetime, but it, too, can be amplified by the uncertainty and tension brought on by a crisis. Because Soviet and U.S. ballistic-missile submarines each carry nearly 200 nuclear warheads, any system to protect the United States from an accident would have to be able to intercept this many warheads arriving in a brief period of time, in a narrow corridor of space, and from any point on the compass.

As for unauthorized attacks, elaborate launch procedures for both land-based silos and submarines are designed to thwart but do not eliminate cases where, for instance, a rogue commander might persuade the officers and crew to launch. Overzealous, psychotic, treacherous, or (especially in the case of the present-day Soviet Union) parochial launch controllers in some renegade region could attempt an unauthorized launch during peacetime, a crisis, or even negotiations aimed at ending a war. Again, the probability of such an episode is higher in a crisis and for submarines.

There are two conceivable ways to avoid the catastrophe of accidental or unauthorized launches of nuclear ballistic missiles.

The first is an ABM system, based either on the ground or in space, that shoots missiles down as they approach the United States. In January 1988, Sen. Sam Nunn (D-Ga.), chair of the Armed Services Committee, suggested that the United States redirect SDI research toward developing a limited shield against a potential accidental or unauthorized ballistic-missile launch. His proposed "accidental launch protection system" (ALPS) would use land-based—as opposed to Star Wars' space-based—high-acceleration interceptor missiles to destroy a few warheads as they reenter the atmosphere. At the end of July 1991, the Senate voted 60-39 to fund essentially this proposal.



NON-THREAT #4:

An enemy

might launch missiles

such as the Iraqi Scuds

against U.S.

military bases

overseas.

While no current interceptor missiles could stop a reentry vehicle, two under development are prime candidates for Sen. Nunn's system—the Exoatmospheric Reentry Interceptor System (ERIS) and the High Endoatmospheric Defense Interceptor (HEDI). Both weapons are relatively short-range; consequently, many of them would have to be deployed to cover the entire perimeter of the nation, given that submarine-launched nuclear warheads could come from the Pacific, Gulf of Mexico, Arctic, or Atlantic basins, and a ballistic-missile attack from the Soviet Union or China would come from the north. Depending on how widely some 200 sophisticated reentry vehicles could spread, Sen. Nunn's idea could require as many as several thousand ground-based interceptors. For now, the Senate has authorized 100 interceptors to be deployed by 1996. Ironically, it wants to base them at the old Safeguard site in North Dakota.

Not only would the ALPS deployment require renegotiating and probably drastically changing the ABM Treaty, but it also could arrest or reverse efforts to reduce the nuclear arsenals of the superpowers. The Soviet Union could perceive an ABM deployment in the United States as a threat to its nuclear deterrent and might then proceed to build more warheads to ensure that its weapons could penetrate U.S. defenses.

Nor could such a system assuredly shoot down every rogue warhead aimed at the United States. The system would be especially vulnerable to low-flying, submarine-launched ballistic missiles and cruise missiles launched close to U.S. shores.

For its part, SDIO has proposed assigning defenses against accidental or unauthorized nuclear attacks to the GPALS system of about a thousand of the so-called brilliant pebbles. However, such a system would offer little protection for two reasons. First, the brilliant pebbles would have to be turned off during peacetime to avoid attacking civilian space launches. Since an accidental or unauthorized launch can't be foreseen, it could occur while GPALS was on non-alert status. Second, only a few brilliant pebbles would be in range of an accidental or unauthorized launch at any time. At best, they could intercept only a fraction of the rogue weapons released by, say, a submarine. And, as with the ALPS proposal, deploying GPALS would destroy

the ABM Treaty, an eventuality some Star Wars supporters might welcome but one most people would oppose. Finally, SDIO estimates the cost of GPALS to be about \$40 billion, but estimates by independent experts put it at twice that price.

Thus neither ground-based nor space-based ballistic missile defenses can deal effectively with the threat of an accidental or unauthorized attack against the United States. Fortunately, a sound alternative exists.

A Fail-Safe Solution

The difficulties of erecting an effective antiballistic-missile system to counter this last type of threat have prompted the emergence of another solution: simple self-destruct devices installed on all ballistic missiles of all nations. Just as NASA safety officers can, and often do, destroy civilian space launches that go awry, so can ballistic missiles carrying nuclear weapons be destroyed remotely.

This approach has two requirements—one technical, one diplomatic. The first is that an opponent couldn't exploit the self-destruct system to blunt an intended nuclear attack. The second is that all nations with nuclear ballistic missiles adopt such self-destruct mechanisms.

Several schemes have been proposed for fulfilling the technical requirement. A ballistic missile is armed at the end of its boost phase by an on-board computer that ascertains it is on the right trajectory. A coded destruct command beamed from one or more safety-control centers in each nation would either prevent the arming process in accidental or unauthorized missiles or incapacitate the warheads in some other way.

There have been numerous suggestions, some simple, some complex, on how to prevent an opponent from intercepting or duplicating the destruct command during an intended attack. A recent research report of MIT's Program in Science and Technology for International Security describes how this can be accomplished by using randomly generated numbers and encrypted codes to initiate the self-destruct procedure. One approach is to have the missile computer and the computer at the ground control center generate a secret destruct code at exactly the same time and to change the code every few minutes. When the missile is launched, a signal automatically notifies the control



THE REMAINING THREAT:

*An unauthorized or
accidental attack might
emanate from the
Soviet Union, China, or any
other nuclear nation with
ballistic missiles.*

center. If the launch is unwanted, the safety control center sends the destruct code to the missile via satellite. The nuclear weapons on the missile disarm when the codes on the missile computer and from the safety control center match.

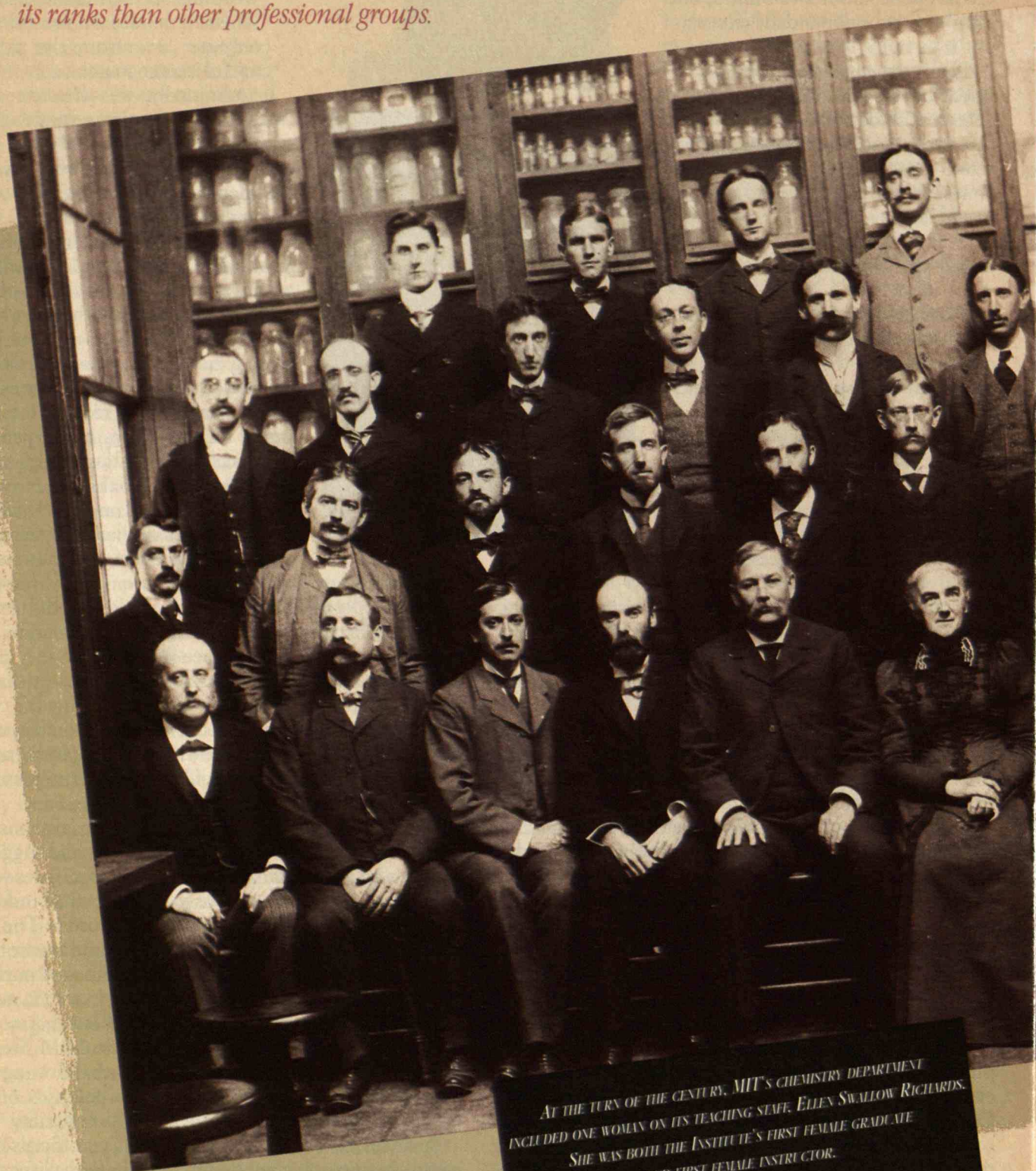
Admittedly, this effective and safe approach raises several technical issues, but all are solvable. For example, where would the receiver of the destruct signal be located? It could be on the missile itself, giving the safety-control center only a few hundred seconds to incapacitate an unwanted launch, or it could be on the individual reentry vehicles, which would allow 15 minutes or more. But putting the receiver on missiles would be relatively simple and inexpensive, while placing it on reentry vehicles would require lengthy and expensive modification of existing reentry vehicles—they would have to be reconfigured and retested extensively unless the self-destruct mechanisms maintained the vehicle's current physical parameters, such as center of gravity and moments of inertia.

Another technical question would be the exact means to incapacitate the warheads. Detonating the nuclear weapon in outer space would generate a giant electromagnetic pulse that would play havoc with satellites and electronics on the ground; detonating the conventional high explosives in the warhead would spread plutonium in outer space. To merely incapacitate the arming or fusing mechanisms could cause intense plutonium contamination at the point of impact.

Not long before his latest Senate proposal to install a ground-based ABM system, Sen. Nunn had suggested that a self-destruct system for ballistic missiles with nuclear warheads be seriously studied, and, indeed, careful investigation of these issues is in order. The advantages are clear-cut: such a system would assure that every warhead in an accidental or unauthorized nuclear attack could be prevented from reaching its target, avoid the political and arms-control complications that would result from violating or abrogating the ABM Treaty, and save tens of billions of dollars by abandoning the irrational pursuit of ballistic-missile defenses of all kinds, ground-based or of the Star Wars variety.

So far at least, no military or government officials have raised objections to a self-destruct system for ballistic missiles. The technology for this solution exists; diplomatic negotiation to adopt it is the rational next step. ■

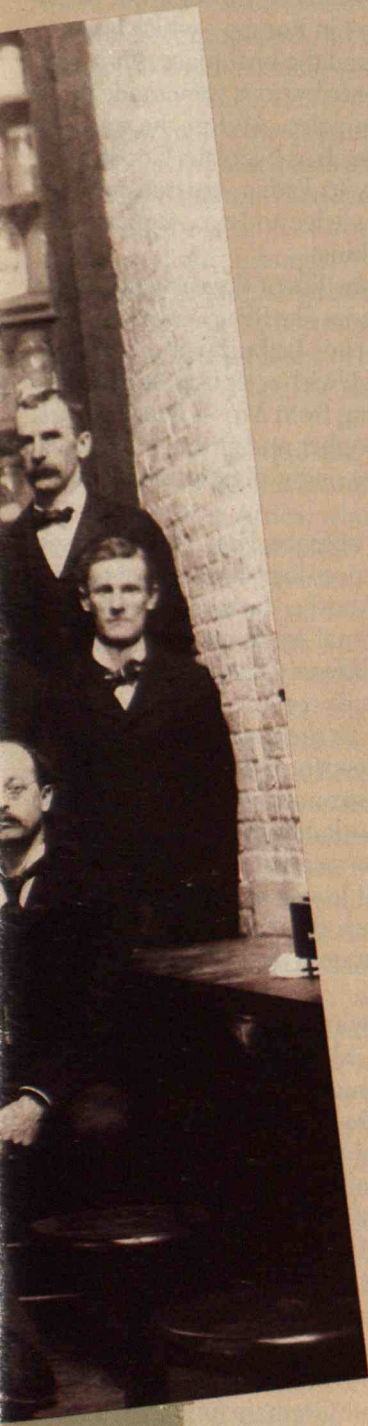
*Scientists consider their world to be unbiased,
but their community has been no more open to diversifying
its ranks than other professional groups.*



AT THE TURN OF THE CENTURY, MIT'S CHEMISTRY DEPARTMENT INCLUDED ONE WOMAN ON ITS TEACHING STAFF, ELLEN SWALLOW RICHARDS. SHE WAS BOTH THE INSTITUTE'S FIRST FEMALE GRADUATE AND FIRST FEMALE INSTRUCTOR.

The Complexion of Science

BY KENNETH R. MANNING



AN editor from *Ebony* magazine recently called me to ask how many blacks are in the National Academy of Sciences. When he had inquired at the academy, as part of a story he was working on, he was told that the organization did not keep a record of its members' racial origins.

After I spoke with him, I called the Country Music Hall of Fame and Museum to ask how many blacks have been elected to its ranks. The spokesperson explained that while the group has no black members, Charley Pride's contributions could no doubt place him among future honorees.

The two communities—scientists and musicians—responded quite differently. Whereas the musical association revealed and remarked on the color of its artists, the scientific group resisted—perhaps because scientists consider their world and their work to be color-free, simply objective. Any suggestion that notice be taken of the color of an individual's skin implies a tainting of basic professional assumptions and perceptions.

Historical evidence, however, does not bear out this notion of science as a unique, tidy, color-blind endeavor. Science has not been immune from general trends in the society at large. The attitude of the scientific community toward diversifying and integrating its ranks has essentially followed the pattern of other social institutions. Traditional "outsiders" in society—such as blacks, Jews, and women—have had to persevere in a centuries-old and continuing struggle for full-fledged participation.

The social dynamics of this struggle have made the scientific community more turbulent, more complex, and ultimately more diverse—whether the community acknowledges it or not. Newtonian optics provides a useful analogy here. On the surface, a ray of light exhibits a uniform makeup. But when viewed through a prism, light scatters into the many colors of the rainbow. Under the prism of analysis, the scientific community similarly reveals its heterogeneity.



SOME OF THE FIRST WOMEN IN SCIENCE INCLUDED (TOP TO BOTTOM)
CAROLINE HERSCHEL, WHO ASSISTED HER FAMOUS ASTRONOMER
BROTHER; MADAME DU CHÂTELET, WHO TRANSLATED
NEWTON INTO FRENCH; AND SOPHIE GERMAIN, WHO
MATCHED WITS WITH MALE MATHEMATICIANS.

In the Beginning

Much can be learned about a community by perusing the names associated with it. During the fifteenth through the seventeenth century in Europe—which is generally considered the birthplace of modern science—contributions were made by individuals from various countries. And in the name of scientific pursuit, scholars such as Nicolaus Copernicus, who traveled from Krakow to Padua, crossed national borders to acquire new knowledge and expose themselves to innovative ways of thinking.

What is striking about any list of the early contributors to modern science—names like René Descartes, Isaac Newton, Gottfried Wilhelm Leibniz, and Andreas Vesalius—is the absence of Jewish scientists. Indeed, the scholarly tradition emanating from Moses Maimonides, the medieval Jewish philosopher and author of medical treatises, suggests that there ought to have been Jews in this group.

Two factors explain their absence. First, widely accepted social exclusionary practices kept Jews out of certain activities and academies. Another factor was culturally specific to Hebrew intellectual tradition. The study of natural phenomena was different from—and in some sense inimical to—the study of the Torah. Hebrew scholarship centered more on theology than on nature. Before 1600, only a few Jewish philosophers took up natural history and some astronomy in connection with the interpretation of holy writ and the reckoning of the calendar. The *Dictionary of Scientific Biography* lists a mere handful of scientists of Jewish origin from this period. Jewish contributors with the stature of a Kepler or a Newton would not appear until the late nineteenth and early twentieth centuries.

The eighteenth century witnessed a trickle of women into the practice of science. Their participation followed the development of Newtonian physics, which, popularized by John Locke and Voltaire, touched virtually everyone in the so-called Age of Reason. By the mid-1700s, a few women who had started to engage in scientific study and research wrote and published works in mathematics, astronomy, and natural history. Madame du Châtelet translated a selection of Newton's work into French under the influence and guidance of Voltaire, who himself could not understand the technical results. Caroline Herschel helped her brother William Herschel in astronomy. Marie Agnesi and Sophie Germain joined their male

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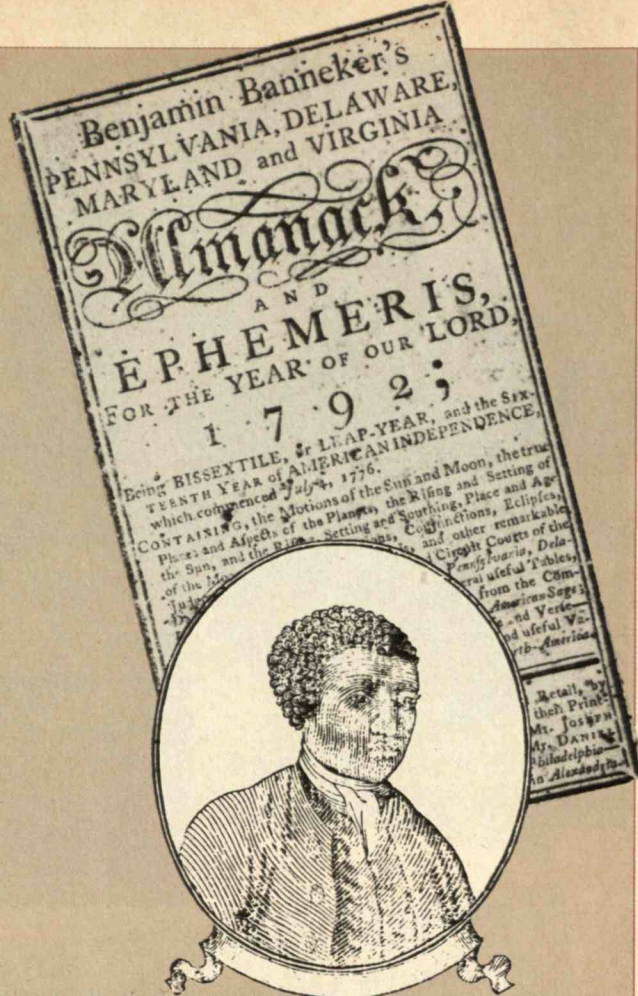
peers in provocative, advanced discussions of mathematics and mathematical physics.

Most often a woman's route into science was through a progressive male mentor—a father, brother, uncle, or lover. Sometimes it was through impersonating a male. Germain, for instance, submitted her academic assignments on mathematical physics under the name of a Monsieur le Blanc. (Perhaps the most notorious example of a woman who masqueraded as a man, James Barry, occurred in the nineteenth century. Upon recognizing her intellectual talents when she was young, Barry's guardians dressed her up as a boy and shipped her off to the University of Edinburgh. After taking a doctor of medicine degree in 1812, she joined the British Army and served all over the world, becoming the second-highest ranking medical officer in the colonial military establishment. The truth about her sex was not discovered until after her death.)

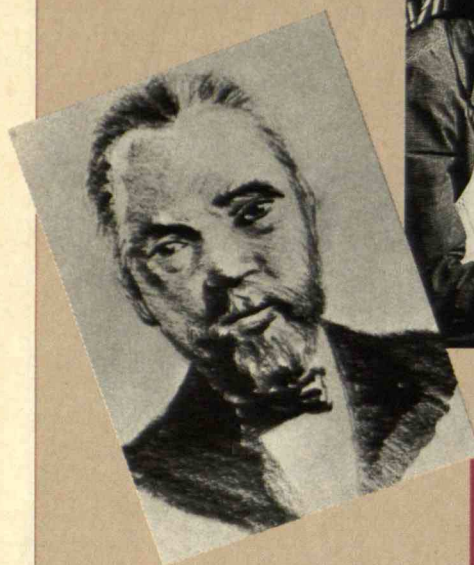
A few blacks also pursued science in eighteenth-century Europe. They included Anthony William Arno, a native of Guinea, West Africa, who earned a PhD at the University of Wittenberg around 1730. Job Ben Solomon, a slave of Fula origin from western Africa and a leading Arabic scholar, worked in London in the early 1730s with the noted English botanist and physician Sir Hans Sloane. And a Monsieur Lislet was named a corresponding member of the French Academy of Sciences for his skills in meteorological observation.

In the United States, Benjamin Banneker, a free black living in Maryland, was recognized as a leading scientist. Thomas Jefferson, who defended compatriots against charges by the Comte de Buffon and other Europeans that no cultural or scientific accomplishment had occurred in the New World, cited Banneker's work as worthy of serious attention. Banneker pursued mathematics, published almanacs, and made astronomical calculations, although he did not attend or have an affiliation with a university. In 1791 he served as part of the team of surveyors and engineers who contributed to the planning of the city of Washington. Banneker was also an outspoken advocate of black equality. He told Jefferson that his own accomplishments were proof that blacks did not possess inferior minds and should pave the way for emancipation of the slaves. Banneker was thus not only one of the first black scientists in the United States but also one of its first scientists to assume a moral voice.

Free blacks constituted the only group of blacks in the United States who had even a meager chance of studying science and engaging in scientific work. For many, scientific research was a mere dream to be realized only after making larger social and political gains. While campaigning for legal emancipation, free blacks also were involved in individual liberation efforts through the underground railroad, marriage, and slave purchase. After the passage of the Fugitive Slave Law, they had to be concerned about maintaining their personal freedom as well.



IN THE 1700s, BENJAMIN BANNEKER (TOP) PUBLISHED ALMANACS, PURSUED MATHEMATICS, AND MADE ASTRONOMICAL CALCULATIONS. PHYSICIAN JAMES BARRY (BOTTOM LEFT), SHOWN WITH HER SERVANT AND POODLE IN 1860, IMPERSONATED A MAN HER ENTIRE LIFE.



NORBERT RILLIEUX (LEFT) INVENTED A SUGAR-REFINING PAN IN THE 1800s. IN THE EARLY 20TH CENTURY, BLACK SCIENTISTS INCLUDED AGRICULTURAL BOTANIST GEORGE WASHINGTON CARVER (CENTER) AND ZOOLOGIST CHARLES HENRY TURNER (RIGHT).

Those who were able to pursue higher education tended to concentrate on law, theology, and letters—disciplines of immediate use in the unfolding social struggle.

Thus by the start of the Civil War no blacks had followed Banneker into pure science. A few studied medicine at places such as Rush Medical College and Harvard Medical School. Medicine fulfilled a notion of community service, and black doctors almost invariably practiced in the black community.

Blacks were also consistently active in the field of invention in the nineteenth century. Those who acquired patents included Thomas L. Jennings, for a dry-cleaning process; Henry Blair, for a corn-planting machine; and Norbert Rillieux, for a sugar-refining pan. While these inventors employed scientific techniques, they were not scientists.

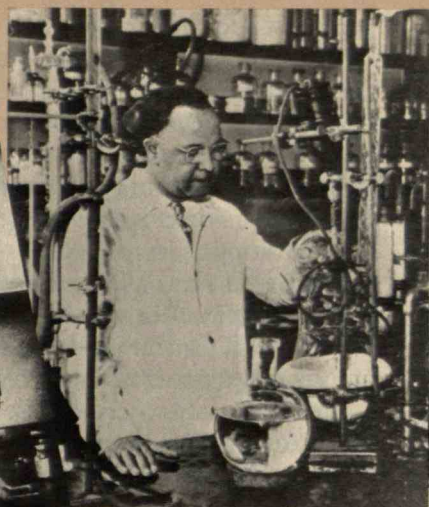
Only with the Emancipation Proclamation of 1863 did any significant participation by blacks in scientific and educational institutions become possible. In 1876, Edward Bouchet became the first black to receive a PhD from a university in the United States—in this case a degree in physics at Yale. And in 1895 black doctors formed the National Medical Association as an alternative to the American Medical Association (AMA), which effectively barred most blacks from membership (and continued to do so until the 1950s). Black associations devoted to science did not really organize, however, until after World War II.

Greater Tolerance, More Opportunities

In the early twentieth century, a handful of blacks began to enter scientific fields. Zoologist Charles Henry Turner, agricultural botanist George Washington Carver, embryologist Ernest Everett Just, chemist St. Elmo Brady, physicist Elmer Imes, and pathologist Julian Lewis were among the more prominent black scientists. Percy Julian, a chemist, and Charles Drew, a pioneer of the blood-banking system, followed in the 1930s and 1940s.

These men pursued research and published in the leading scientific journals of the day. All did graduate work in science at major white universities. Yet prior to the Second World War, black scientists' careers were almost exclusively tied to black colleges and universities, except for seasonal research in laboratories such as the Marine Biological Laboratory at Woods Hole, Mass. Among the blacks who worked at Woods Hole were Turner, Just, the biologist Samuel Milton Nabrit, and a female zoologist, Roger Arliner Young.

Often confronted by the prevailing racial attitudes of the time, these scientists nevertheless managed to produce work at the highest levels in their fields. In the 1910s, for instance, Just demonstrated that the egg plays a role as essential as the sperm during fertilization. At Woods Hole, he worked in an environment that was simultaneously nurturing and hostile. Beyond the confines of his laboratory, he and his family were excluded and subjected to



OTHER BLACK SCIENTISTS IN THE FIRST HALF OF THE 1900'S WERE (LEFT TO RIGHT) EMBRYOLOGIST ERNEST EVERETT JUST; CHEMIST PERCY JULIAN; CHARLES DREW, A PIONEER OF THE BLOOD-BANKING SYSTEM; AND FEMALE ZOOLOGIST ROGER ARLINER YOUNG.

subtle racial slurs.

Just had a deep, personal commitment to science, and in the 1930s left the United States to pursue his work in the more racially congenial climate of Europe. But his experience at Woods Hole in the 1920s paved the way for other blacks. After Just, it was no longer as shocking to see a black researcher walking around the laboratory and local streets, and joining in the social life of the place. However, it remained difficult for blacks to find lodging in such all-white communities.

Funding played a major role in blacks' involvement (or lack thereof) in science. Until the 1920s, blacks received no systematic outside support for scientific work. The first important help came through National Research Council (NRC) fellowships supported by Julius Rosenwald, an owner of Sears, Roebuck, and Co., as part of his generous support for, among others, blacks. Also in the 1920s, the chair of the NRC's Division on Biology and Agriculture talked about establishing long-term support for scientific research at black institutions to replace the piecemeal fellowship approach. Otherwise, the only significant source of funding was the Rockefeller Foundation. But while the foundation supported black medical schools, it would not set up major research endowments at black universities and colleges.

Meanwhile, in Germany, Jews were coming into their own in science. Before World War II, the associated institutes of the Kaiser-Wilhelm Society in Berlin-Dahlem, founded in 1910, permitted Jewish scientists such as

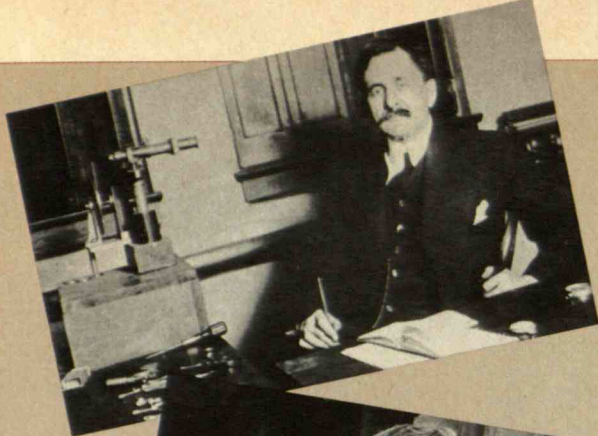
GENTLEMEN:

... The Fisk Mathematics Department hereby requests the American Mathematical Society and the Mathematical Association of America to insert into the respective by-laws of the two organizations explicit and effective protection of the rights of all members to participate fully, freely and equally in the affairs of the organizations without regard to race, creed or color. . . . One of the events which demonstrate the need for such official action occurred in connection with the annual meeting of the southeastern region of the Association, March 16-17, 1951, with Peabody and Vanderbilt as hosts. The official program of the meeting announced a dinner at which the national President of the Association would be the speaker. The chairman of the Fisk department requested four reservations in a note handed personally, on March 10, to the individual specified on the announcement. On March 15, the day before the banquet, the chairman of the arrangements committee telephoned Fisk to inquire if any of the four reservations would be used by Negroes. On receiving an affirmative reply, he declared the reservations cancelled, stating that the arrangements committee would issue no tickets to Negroes. . . .

Sincerely yours,

EVELYN BOYD, Associate Professor
WALTER BROWN, Assistant Professor
H.M. HOLLOWAY, Assistant Professor
LEE LORCH, Assistant Professor and Chairman

SEVERAL FISK UNIVERSITY FACULTY
PUBLISHED THIS LETTER OF PROTEST
IN SCIENCE MAGAZINE IN 1951.



Jews in science in the first half of this century included (top to bottom) physicist Albert Michelson, physiologist Jacques Loeb, physicist Robert Oppenheimer, and biophysicist Selig Hecht.

geneticist Richard Goldschmidt and the Nobel laureate biochemists Otto Meyerhof and Otto Warburg to join their ranks.

While anti-Semitism prevailed at academic institutions in the United States, it did not operate in a totally exclusionary way. A quota system served to limit—but not bar—Jewish admissions to graduate and medical schools and the hiring of Jewish faculty at major universities and research institutes. With the reputations of the physicists Albert Einstein, Albert Michelson, and others to support them, Jewish students and scientists began to spread out among major universities and research institutions in the United States. Some served in key scientific and administrative roles. And many, such as physiologist Jacques Loeb, physicist Robert Oppenheimer, the Flexner brothers (Abraham, the first director of the Institute for Advanced Study in Princeton, N.J., and Simon, a medical researcher), and biophysicist Selig Hecht, maintained a tradition of acute social awareness and moral energy generated partly by their personal experiences of ethnic intolerance.

Just as a century or more earlier, when some women resorted to male impersonation to enter science and the professions, Jews and blacks had their own methods of subterfuge. The common Jewish technique in eighteenth- and nineteenth-century Europe was to convert, to become baptized, and to acquire documents forging a new identity. In the United States, the tradition carried over and came to involve a simple name change—for example, from Abraham to Allendale.

The solution was not quite so simple for blacks, but there were several cases of what came to be known as “passing”—light-skinned blacks allowing themselves to be taken as white to secure educational and career opportunities. Some people assumed whole new lives and identities. Other blacks carried on the masquerade only part way, maintaining contact with and conveying useful information to the black community.

Meanwhile, in the late nineteenth- and early twentieth-century United States, women slowly became visible participants in science. They often graduated from and held positions at such women’s colleges as Bryn Mawr and Mount Holyoke and occasionally at major schools like the Universities of Chicago and Pennsylvania. Many took up the biological sciences, working at the Marine Biological Laboratory—one of whose founders was the Women’s Education Association—and other places. Some women worked alongside their husbands. Sally Hughes-Schrader and Rebecca Lancefield, for example, made the annual trek to Woods Hole with their spouses, Franz Schrader and Donald Lancefield. Other women, such as Libbie Hyman at the MBL and Barbara McClintock at Cold Spring Harbor, worked alone.

Rarely did women achieve a rank comparable with their male peers. For the most part, they were relegated to adjunct or research associate posts. Only after World War II did this pattern begin to change.

Continuing Barriers

Jews became much more established in science and academia by the end of the Second World War, as a result of immigration and growing concern over their treatment by the Nazis. The war brought some—but far more limited—public notice to black scientists. At Los Alamos and at universities and research labs working on the Manhattan Project, white scientists witnessed for the first time black scientists entering their world. Blacks who worked on the bomb project included physicists Edwin R. Russell and George W. Reed and chemists Moddie D. Taylor and the brothers William J. and Lawrence H. Knox. In a 1946 talk at the American Physical Society, the physicist Arthur Holly Compton remarked that the bomb project revealed the extent to which “colored and white, Christian and Jew” could work together for a common purpose.

Around the same time, a few white universities opened up opportunities for black faculty members as well as for blacks seeking graduate training. Still, other obstacles lingered: lack of access to high-quality elementary and high school science programs, weak undergraduate curricula in certain black colleges, exclusion from admission to many white colleges, and the high cost of graduate training.

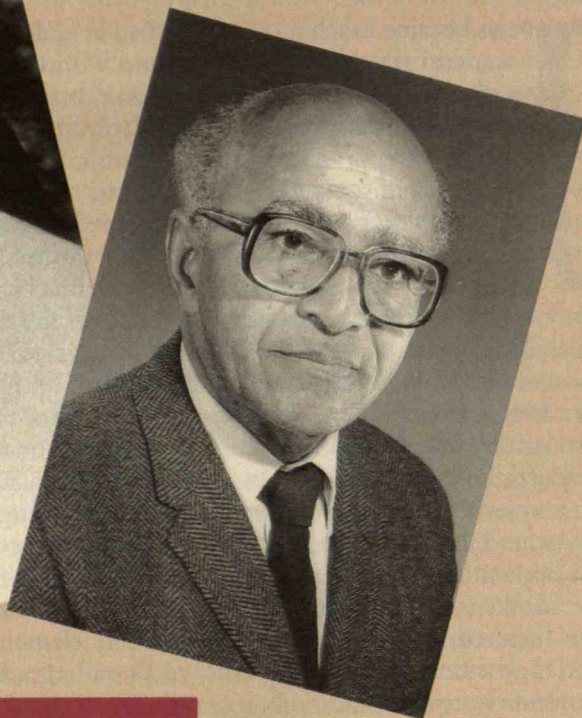
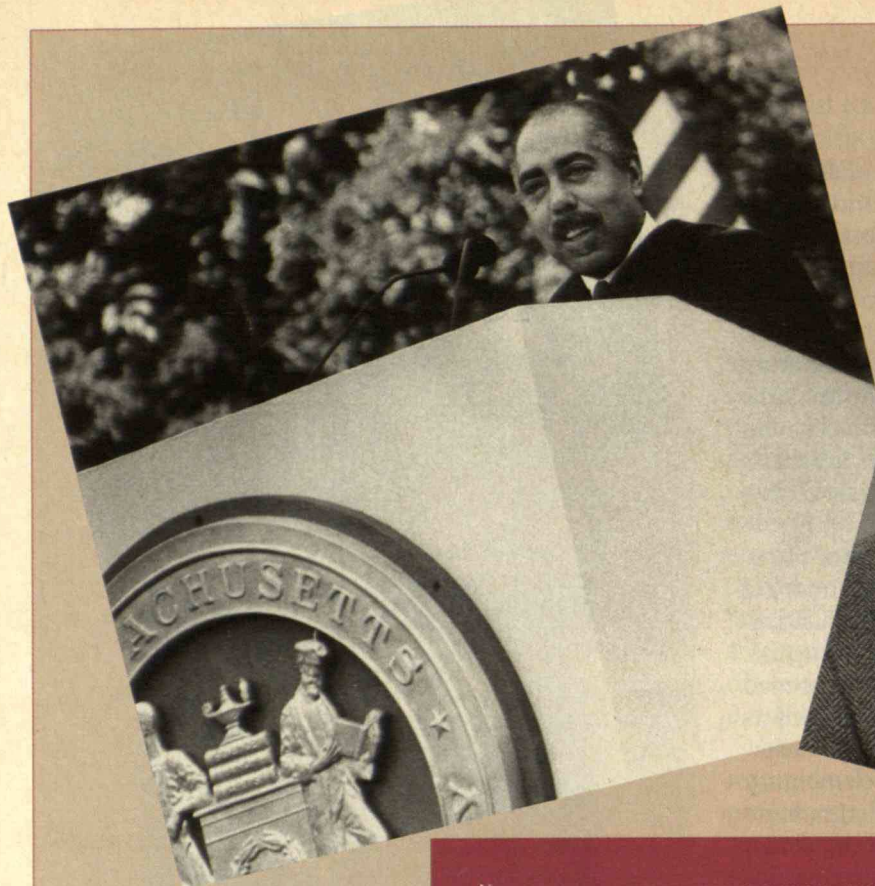
Another major problem was continuing systemic discrimination in the professional world of science. As late as the 1950s, meetings of national scientific groups such as the American Association for the Advancement of Science (AAAS) were held in segregated cities such as Atlanta and New Orleans where conference hotels would not give black scientists accommodations. In a letter published in *Science* in 1951, several Fisk University faculty protested the denial of banquet tickets to black participants at a Nashville conference of the Mathematical Association of America.

Inclusion, integration, diversification—these efforts moved as slowly in science as in any other social institution. The attitudes of many white scientists continued to be unenlightened. Consider letters of evaluation written in the 1940s by scientists at a major northern university concerning a black doctoral candidate in physics. One faculty member wrote that the candidate “has more analytic ability than any Negro I ever expected to meet.” Another wrote that the man “has more mental ability than we had supposed possible in a Negro; in fact he is the equal of a considerably above-average white graduate student in all respects (including analytical ability).”

For that matter, despite the increasing acceptance of Jews in science, professors often stereotyped Jewish graduate students crudely. Consider the case of one academic dean who wrote that a student “is one of two Hebrews in class. Has none of traits common in Jews of commercial class. Likeable, perfectly frank and open, does not show forwardness which might be anticipated.” The



TOP: BIOLOGIST BARBARA MCCLINTOCK (RIGHT), WITH RESEARCH COLLEAGUES AT CORNELL UNIVERSITY IN 1929, WENT ON TO BECOME A NOBEL LAUREATE. CENTER: SALLY HUGHES SCHRADER DID RESEARCH WITH HER HUSBAND AT THE MARINE BIOLOGICAL LABORATORY (MBL) IN WOODS HOLE, MASS. BOTTOM: FEMALE TEACHERS AND INVESTIGATORS WORKED IN AN MBL BOTANY CLASS AT THE TURN OF THE CENTURY.



NOTABLE BLACK SCIENTISTS TODAY INCLUDE PHYSICIST AND NATIONAL SCIENCE FOUNDATION DIRECTOR WALTER MASSEY (LEFT) AND MATHEMATICIAN DAVID BLACKWELL OF THE UNIVERSITY OF CALIFORNIA AT BERKELEY.

university, the dean commented, "could not do better if there is room for one of his race."

As for blacks, their lack of inclusion within major white institutions with a wealth of financial and other assets was astonishing. The first black who graduated from Johns Hopkins Medical School, for instance, did not do so until 1967. For many decades, a national resource like Hopkins was unavailable to blacks.

In contrast with most white scientists' lack of interest in minorities, black scientists often directed young talented blacks into the field. The first to take on this role of mentor included physicist Herman Russell Branson of Howard University and Milton Nabrit of Atlanta University. Particularly noteworthy is chemist Henry C. McBay. After doing extraordinarily well in the doctoral program at the University of Chicago, McBay began teaching in 1945 at Morehouse College. Over the next 30 years, his persistent guidance and mentorship inspired more than 40 blacks to obtain PhDs in chemistry and allied fields.

The 1964 Civil Rights Bill marked a milestone in educational opportunities for blacks and other minorities. Many white colleges and universities created openings for them at both the undergraduate and graduate levels. As a result, academic and industrial careers in science became a firmer reality for black students.

In the same period, the Macy Foundation, Commonwealth Fund, and Ford Doctoral Fellowships program began filling a void in direct support of blacks pursuing scientific research. In the early 1970s, the National Science Foundation followed suit. Even though a closer look at funding practices today reveals that minorities still win proportionately fewer grants, such organizations did play a role by making important gestures.

The 1970s and 1980s also saw efforts by scientific organizations, universities, and learned societies to make their membership policies more inclusive. The AAAS set up the program, "Opportunities in Science," to address the question of minority underrepresentation in science. Within in the last five years, the AAAS elected Sheila Widnall, a woman, as its president, and then, for the first time, a black, Walter Massey. (Recently, Massey became director of the National Science Foundation.) These leaders convey powerful messages about the makeup of the scientific community.

Still, the representation of blacks in scientific careers today hovers around 2 or 3 percent. Recent intervention has been more successful at bringing women into science than at bringing in blacks. In 1986, women constituted 15 percent of all scientists and engineers, up from 9 percent a decade earlier.

Broadening the pool of blacks will require more concerted effort. The reality of the situation does not live up to the rhetoric of political leaders. For instance, President Bush's speech at the annual meeting of the AAAS in 1991 alluded to the great opportunities science presents for the development of, among other things, human resources. But the country's social fabric must change radically for that promise to be realized.

One needed change concerns elementary and high schools. While racial integration has supposedly opened up routes of access, a disguised form of segregation known as "tracking" has been commonplace for decades. This system assigns students to courses by ability groups. Since it is deeply ingrained in our culture and society that blacks have inferior minds, particularly for deduction and analysis, counselors and teachers often steer black students away from the rigorous scientific and mathematical courses necessary for future training in science.

And when minority students survive high school and find themselves at prestigious universities that are largely white, professors often have lower expectations for their performance. This situation is more insidious and often more destructive than an openly segregated one.

Science education is a cumulative process, and training proceeds along well-established routes. It is not easy to overcome a detour along the way. The United States needs to push an aggressive campaign of support, encouragement, and opportunity throughout the educational pipeline, from preschool to graduate school. The Quality Education for Minorities Network in Washington, D.C., has embarked on just such a mission.

Politicians have widely proclaimed science the bedrock of the future. While science has inspired awe in the United States, however, it has been sparing in its invitation to participate. This may be one reason why, to answer the *Ebony* editor's question, the National Academy of Sciences has just one black member, David Blackwell, a mathematician at the University of California at Berkeley.

To return, then, to our Newtonian analogy: as light passes through the prism, we discern the myriad colors of the rainbow. In the scientific community, perhaps we are witnessing the beginnings of a prismatic effect. The colors have been muted periodically by the force of social and political circumstances. But to carry the analogy further, recall how Newton took a second prism, positioned it in the path of the refracted rays and resolved the component colors again into one ray. When we do that, we are in an entirely new position. We can see both the separated rays and the unified ray—signifying the capacity to focus, embrace, and focus again. If we do not follow through with both parts of the experiment, choosing to fall back instead on the colorless image of what people like to call "scientific objectivity," we could forgo a rich, diverse level of participation by all who want to be part of the scientific enterprise. ■

Images and Icons

AT certain junctures in history, ritual and symbolism influence the complexion of the scientific community. The Nobel Committee chooses honorees yearly. And cultures create symbolic communities of scientists, just as they do artists, musicians, and politicians. In Paris, one strolls along streets named rue Descartes and rue Pasteur.

Or consider MIT. When walking in front of the Institute, one looks up to see names topping the crowns of the buildings. The largest letters are reserved for Aristotle, Newton, Franklin, Pasteur, Lavoisier, Faraday, Archimedes, da Vinci, Darwin, and Copernicus. Considerable thought went into the selection of names around 1916, when MIT built its Cambridge campus. Each department had a say in

who would be included, where the names would be placed (in order of importance), which fields would be represented, and so forth. Benjamin Franklin, for example, is prominently placed because of special concern to include someone from the United States. A community was being created, a community of so-called greats. There were no women, no Jews, no blacks.

The grouping of names in print by editors, historians, and self-appointed selectors has also had significant impact on defining scientific communities. The *Dictionary of Scientific Biography* is an authoritative directory—and a builder of reputations. Thus the omission of Benjamin Banneker (a nineteenth-century black scientist) in the dictionary's 1970 edition caused turmoil and embarrassment for the publication's editors and was the subject of comment in the *New York Times*.

And then there's *American Men of Science*. Its title was not



changed to *American Men and Women of Science* until the twelfth edition in 1971—even though women had been represented since the first edition in 1906. What's more, the directory's fourth edition, in 1927, had about 13,500 sketches, but only four of these were black. Just one black—Ernest Everett Just—was listed with a star, an honor awarded to those who had been selected by a poll of leading scientists.

Smaller examples of symbolism can easily be found, too. For instance, the 1988 centennial calendar of the Marine Biological Laboratory at Woods Hole, Mass., featured pictures and biographic captions of 12 of the major scientists who have worked there. The scientists included cell biologist Edmund Beecher Wilson, Jacques Loeb, and E.E. Just, among 9 other men. The absence of women is unfortunate. Many of the nation's top women biologists—Rebecca Lancefield, Libbie Hyman, Sally Hughes-Schrader, and others—have worked there.

As communities of "great" scientists become established—be it through biographical dictionaries, colonnades, or any number of media—messages are conveyed that determine the public's perception of science and its practitioners.

Is there the equivalent of the ubiquitous baseball card that could broaden the number of budding scientists?—Kenneth R. Manning ■

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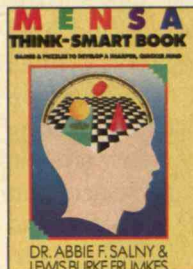
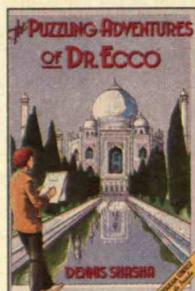
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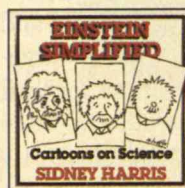


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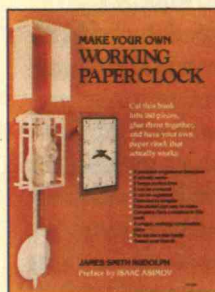
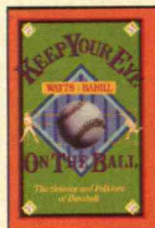


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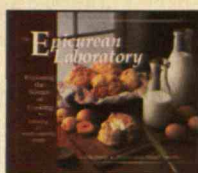
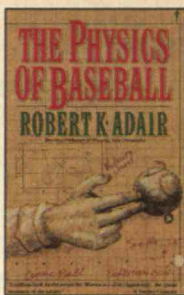


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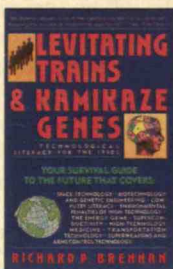
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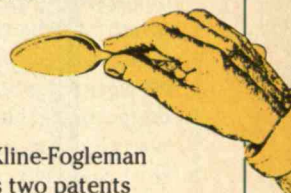


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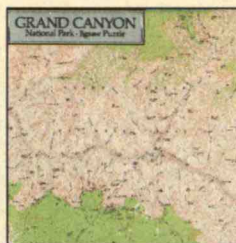
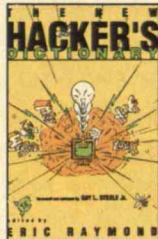


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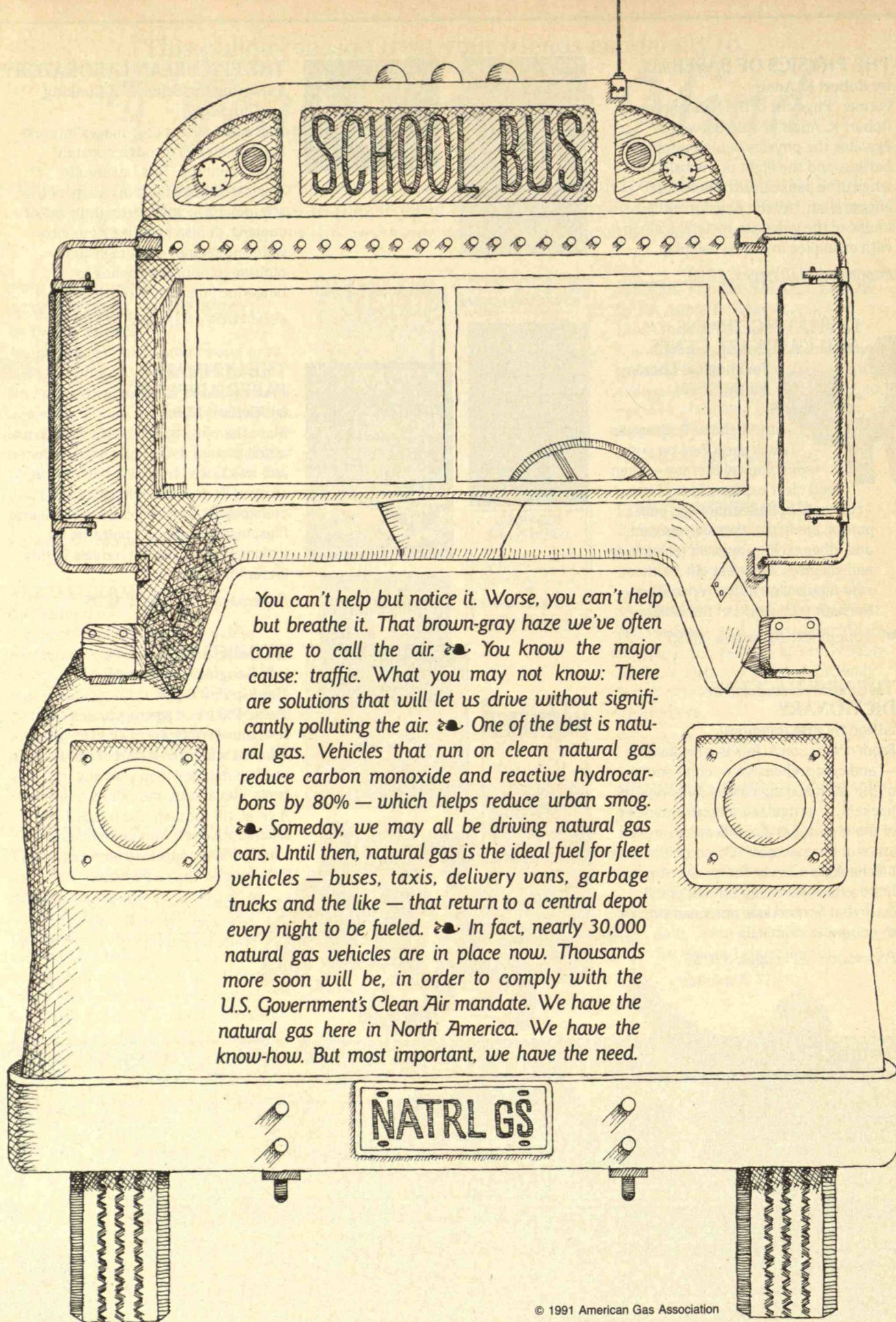
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The U.S. Edge Over Japan

Japan has earned a reputation for swiftly and effectively carrying ideas from the laboratory to the market. Japanese companies are often said to be better organized, better motivated, and better financed than their competitors in the United States. It seems to me, however, that the U.S. system of innovation has some clear advantages over the Japanese one.

The United States is still much more capable than Japan of making big technical leaps. The Japanese style of technological innovation focuses on incremental improvement based on a carefully thought out technical plan, with attention to quality, manufacturing, and cost. But this process does not allow for the unexpected. That's why the Japanese may beat the United States in cameras and color copiers but they will not—at least in the beginning—dominate opportunities that require novel combinations of technologies, such as multimedia computing. Nor will Japan excel in rapidly moving fields of science. For example, the revolution brought about by molecular biology, where laboratory advances become initial public stock offerings in the wink of an eye, is unimaginable in Japan.

Many complain that Japanese industries receive an unfair competitive advantage because of government support for technology development; this backing has been particularly visible in supercomputers, ceramics, and semiconductor manufacturing. Actually, Japanese firms compete ferociously among themselves, in both international and domestic markets; this competition may account for superior Japanese performance in manufacturing. But in any case, I don't view Japanese government support for cooperative technology development as unfair—I just wish the United States could do it better.

Japan's Ministry of International Trade and Industry (MITI) achieves cooperative technology development by catalyzing efforts among many firms in fields judged to be strategic. The United States, on the other hand, finds it difficult to agree on the appropriate role of

the federal government in the development of civilian technologies. Many U.S. policy makers are skeptical about the government's ability to choose technology winners and losers. The United States also has an unfortunate history of political influence in federally sponsored efforts to develop civilian technology.

But our inability to agree on effective mechanisms for cooperation should not lead us to condemn the Japanese approach. Rather, we should try to make better use of the considerable skills that exist in our universities, industries, and national laboratories—skills that add up to, in effect, a “creative edge” over Japan.

Japanese universities, for example, still trail their U.S. counterparts in science and engineering research. Few faculty members have active research programs. Although we hear much about the extreme competition in the Japanese pri-

Much to the dismay of Japanese university officials, Japanese corporations are more interested in dealing with U.S. universities than with Japanese ones.

Because the Japanese depend on access to U.S. technology in general and U.S. universities in particular to maintain their pace of innovation, some have proposed that the United States insist on reciprocity—that is, that U.S. companies be granted similar access to Japanese technology. But such reciprocity is unlikely to work. The Japanese want access to U.S. universities, but there is no equivalent interest among U.S. researchers in Japanese universities. U.S. interest centers on Japan's industrial design and manufacturing expertise, which Japanese companies have little incentive to share.

Rather than seeking reciprocity, the United States should focus on assuring that U.S. companies have access to the



mary and secondary school system for entry into the best universities, Japanese youth do not view their university experience as a demanding time. In fact, the Japanese continue to rely on work experience in the industrial laboratory—often after a postgraduate period in a U.S. university—to instill the craft of research.

Moreover, the infrastructure of Japanese universities—their libraries, laboratories, and computers—does not compare to that of U.S. universities. And Japan has virtually no activity comparable to the resurgence in the United States of cooperative research between universities and industry in areas ranging from biotechnology to microelectronics.

considerable Japanese market and on doing better at home. More federal R&D dollars should flow into civilian technology development. U.S. companies can no longer expect to find comfortable market niches where mass production is assured without competition. And greater priority should be given to collaborative relationships—between universities, industry, and national laboratories—that address the key issue of making things well.

JOHN M. DEUTCH, Institute Professor at MIT, was formerly provost and dean of science. He has also been undersecretary of the Department of Energy and director of energy research.

When Technologies Die, Do We Mourn?

As a tried and true technology confronts a flashy new model, the old one is abruptly thrown on the junk heap. The terms we use to talk about the process are cold and scornful: obsolete, outmoded, antiquated, passe. We all participate in this process with seeming enthusiasm, driven by a modern ideology that tells us innovation brings a better way of life.

But what of the technical artifacts we've come to care about, the ones we've used for years and regard with fondness? How do we feel about their sudden extinction when something "new and improved" comes along? Can it be that technological progress contains an unspoken undercurrent of remorse?

Consider the case of the long-playing record, a beloved technology now in its death throes. Unlike its 78-rpm predecessor, the LP reproduced sounds with excellent fidelity, bringing the delights of classical music, jazz, blues, and rock into the homes of millions. For many who owned and played them, LPs became much more than a reliable recording medium. Conspicuously displayed in living rooms and studies, record albums revealed much about a person's taste and character. And because the discs were vulnerable to scratches, dust, and wear, they needed meticulous care. Serious listeners followed elaborate protection rituals requiring the most exquisite kinds of cartridges, cloths and cleaning fluids.

With the coming of the digital compact disc, however, the world of the LP is rapidly vanishing. "It's just a fad for wealthy audiophiles," I told myself as CDs began creeping into stores in the mid-1980s. "Record buyers on a budget won't pay such ridiculously high prices." But within a few years, CDs have taken over completely; along with cassette tapes, they now make up virtually all of any record shop's supply. Record companies are emptying their warehouses of black vinyl and announcing that they will make no more.

From one point of view this transition is easy to accept. You simply acknowledge that CDs offer improved

sound in a more robust package less susceptible to the frailties of LPs. But what are we to do with the part of us that is emotionally wrapped up with the old discs? Much of my own life is "in the grooves" of LPs by John Coltrane, Little Richard, Isaac Stern, and the Boston Symphony Orchestra, and countless others. Replacing these wonderful treasures with glossy little CDs seems downright sacrilegious.

Some diehard LP enthusiasts insist that CDs are inferior, that analog recordings were somehow "warmer" and "better balanced" than today's digital discs. But these claims reflect sentiment rather than fact. True, some CDs are terribly shrill. (Must the soprano's voice sound as if a microphone had been plunged down her throat?) But the problem stems from inept production—an overzealous pursuit of clarity and precision—rather



than any flaw in the technology itself. When tailored to high artistic standards, CDs are clearly superior to anything possible in the earlier mode.

The complaints of the LP faithful would be better focused not on implausible technical comparisons but on the sense of personal and cultural loss that accompanies the shift from one medium to another. No one could feel worse about this shift than Peter Goldmark, Jr., president of the Rockefeller Foundation, whose late father invented the LP some 40 years ago. "My wife bought a CD player," Goldmark told an interviewer. "I can't tell you how much that hurt."

What seems most difficult to admit in an age of rapid innovation is how strongly involved we become with some of the objects we use. We seem embarrassed to admit how much personality—our own personality—is invested in the things our society expects us to discard with a shrug. Many men, for example, quietly lament the loss of automobiles that they could repair at home without complicated electronic tools and factory training. Some writers still cling to their Underwood typewriters, preferring the bang and clunk of the keys to the effortless flexibility of word processors.

Oddly enough, the pain of technical change is depicted most clearly in the stories we tell our children. Basic to many classic American myths is the destruction of the hero by relentless technological advance. John Henry, the "steel drivin' man," lays down his hammer and dies after a contest with a

powerful steam engine. Paul Bunyan fails in his attempt to out-chop a log-cutting machine and vanishes into the wilderness.

Such tales note the inevitability of technological advance while acknowledging its sorrows. They suggest that at a deeper level we must somehow mourn the passing of outmoded tools and the ways of life connected to them.

LANGDON WINNER is visiting research scholar at the Center for Technology and Culture, Oslo, Norway. His most recent book is The Whale and the Reactor. He has written music criticism for The Atlantic Monthly and other publications.

Reviews

BOOKS

BOTTLING TOM CLANCY

Soft Wars

by Selmer Bringsjord

New American Library, \$5.99

BY DAVID BARBER

IN the popular imagination, writers are vexed souls who ply their trade by courting bolts of lightning. In reality, of course, literary creativity can often be as mechanical as it is mysterious. Take the genre novel—detective yarns, spy thrillers, historical romances, and the like. Successful practitioners of these forms invest a sturdy fictional formula with just enough kinks and trimmings to satisfy a reader's yen for several hours of reliable diversion. The Barbara Cartlands, Louis L'Amours, and Erle Stanley Gardner aspire to punch out diecast plots and failsafe denouements as methodically as well-oiled machines.

Which brings us to Selmer Bringsjord, 32-year-old computer professor and debut novelist, whose ambition is merely to take the process a quantum leap beyond. He doesn't want to write like an automaton—he wants to transform the ghost in the machine into a competent literary muse. *Soft Wars* may look like any other beach-worthy tale of superpower skullduggery. But to adopt the lingo of its own spy genre, the book is actually a kind of double agent: in one life it is meant to be a ripping good read for technothriller buffs, while in another it is intended as a model for artificial intelligence savants who hope to program computers to write the novels we'll be toting to the beach in the next century.

Bringsjord, who teaches computer science and mathematical logic at Rensselaer Polytechnic Institute, is a charter member of a groundbreaking team project launched this summer under the



rubric of Auto-Poesis 2000, a 10-year interdisciplinary undertaking sponsored by the Luce Foundation and Apple. Its aim: to develop software that can produce "autonomously generated fiction."

According to Bringsjord, anything more ambitious than the simplest children's story is beyond the reach of today's artificial intelligence. But by decade's end, he and his colleagues hope they'll be able to hit a key and stand by as their computers grind out fair replicas of the escapist novels that fill the racks at airline terminals and checkout counters. If successful, this enterprise would propel artificial intelligence more deeply than ever into the terra incognita of artificial creativity.

All this sounds compelling in the abstract. But practically speaking, it's a mission that at the moment must kindly be characterized as quixotic. Indeed, we need look no further than *Soft Wars* as an index of how remote and implausible the whole scenario remains.

Bringsjord began work on the novel seven years ago when a colleague suggested that his designs on masterminding a computer program to write genre fiction might be infinitely enhanced if he first tried his hand at a novel himself.

Chastened, this avid reader of military thrillers and murder mysteries started to plug away on the manuscript of *Soft Wars*. Unlike your average fledgling novelist, however, Bringsjord was simultaneously dissecting his storytelling to flesh out the structural principles of a "story generator" program that would rationalize the creative decision making underlying formula fiction.

Dubbed Cinewrite for its debt to screenwriting schematics, the program Bringsjord fashioned out of the throes of *Soft Wars* is not the self-propelled yarn spinner he ultimately seeks. Rather, it is a step along the way—an aid for human writers. It presents the writer/operator first with a "genre generator" and then with a "storyboard" with which to set up the parameters of a beach-blanket novel. Composition proceeds in earnest as Cinewrite's storyboard prompts the operator to structure narrative by way of an x-axis (character development) and a y-axis (plotting), hewing to Aristotle's injunction to advance narrative through character conflict.

Bringsjord says he's writing *Eternal Return*, a sequel to *Soft Wars*, entirely under the cues and commands of his new software. The genre generator has already set up the framework for a "large multi-narrator technothriller," providing him with a fixed number of characters, movements, and scenes. The storyboard has asked him to create characters by filling in two dozen or so key attributes, ranging from hair color to "overriding goals," and has prodded him to sketch out the contours of the plot by blocking in points of conflict as the various characters move toward said goals.

As Bringsjord taps away, the program continues to prompt him on three increasingly concentrated levels. First, he flashes on to the "plot loop," which asks him to solidify the novel's general organization and structural dynamics. Next, he clicks into the "visualization loop," which signals him to compose and refine his narrative scene by scene. Finally, he calls up the "polish loop,"

which presses him to fine-tune his prose and elements of style. At each juncture, actual composition of text proceeds as Bringsjord "answers" the inquiries of his software—plugging in a detail as minute as a villain's perpetual stubble or a passage as dense as a climactic aerial dogfight.

Whether this collaboration between human and machine will spawn anything resembling an honest-to-goodness pageturner awaits the evidence of a completed manuscript. But judging by *Soft Wars*, all signs point to a boondoggle. For starters, the professor's warm-up novel already reads as if it had been dictated by a computer—and a rather obtuse one, at that. Will Cinewrite be able to cure what appears to be a terminal case of stultifying language? Can the polish loop do anything to police an outbreak of mind-numbing clichés?

Taking a cue from Tom Clancy—author of *The Hunt for Red October* and other technothrillers—Bringsjord has grafted a seminar's worth of technical erudition onto a resolutely low-brow storyline. The hero of *Soft Wars* is a dashing computer wizard and daredevil who must save the Free World, circa 1992, from a Soviet plot to score the ultimate nuclear victory with pirated microchip technology. Not unpromising as spinetingers go (recent real-world events notwithstanding), but the novel turns out to be so toneless and ponderous it makes Clancy sound like Proust. When one of Bringsjord's dense discursive passages on semiconductors or particle-beam physics segues into another inert scene populated by cartoonish Russian heavies or cardboard CIA spooks, it turns the readers' willing suspension of disbelief into a taffy

pull. Never mind the deadly face-off between superpowers—*Soft Wars* is a tale at war with itself, a textbook grappling tooth and nail with a comic book.

Since *Soft Wars* falls flat even by the undistinguished standards of the K-Mart novel, it's only natural to ponder whether there is more than a little hubris involved in the visionary presumptions underlying Cinewrite and Auto-Poesis. Bringsjord says his research is an attempt to "formalize intuitive notions" to whatever extent he can, to render what goes on in writers' heads in computational terms and programmable properties. He states frankly that one implicit aim is to demystify the act of creativity and dim the sanctified aura surrounding art. The more he develops Cinewrite, he asserts, the more he'll be able to incorporate the actual dynamics of writing into the Auto-Poesis sto-

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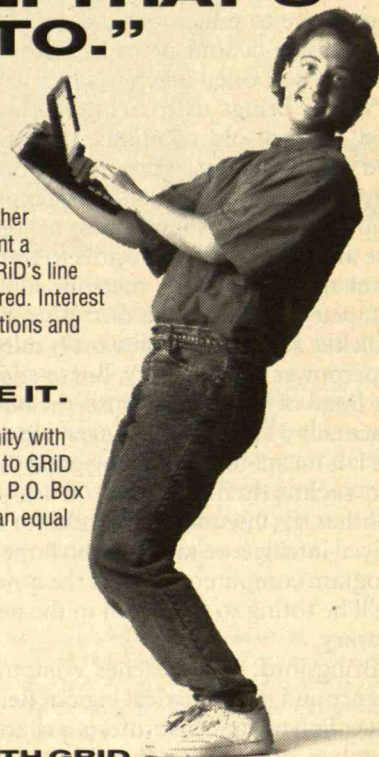
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ry generator, giving the program the logical and causal dimension necessary to construct meaningful narrative.

The irony, of course, is that the muddle of *Soft Wars*—the supposed model for all this—only deepens the mysteries of art and reinforces the unquantifiable kinetics of language. Good storytelling can never be the sum of diligent coordinates or the end product of thematic calculations, even when it takes the form of a paint-by-numbers novel. That doesn't mean our notions of creativity shouldn't advance beyond a reverence for lightning rods. What it does mean is that the braintrust behind autonomously generated fiction might ask themselves whether writing that's devoid of expressive vitality and imaginative vigor is worth producing at all. ■

DAVID BARBER, a free-lance writer living in Somerville, Mass., received the 1991 PEN Discovery award for poetry.

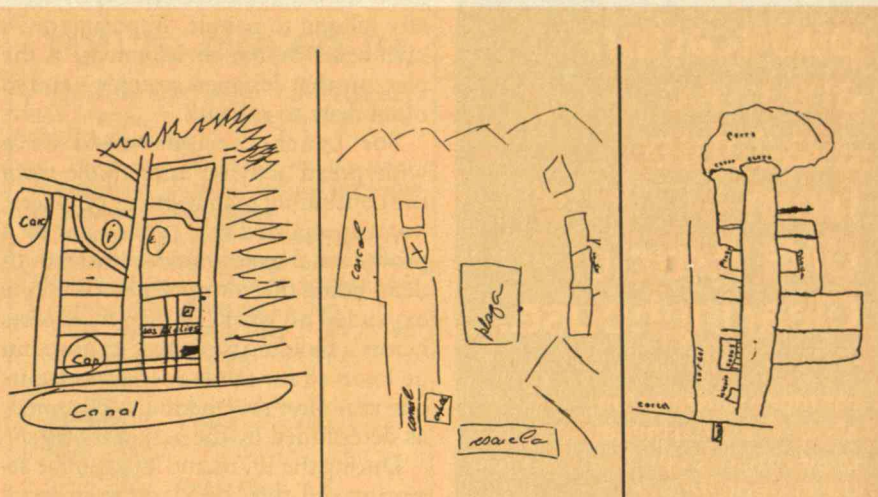
BOOKS

URBAN PLANNING WITH A HEART

*City Sense and City Design:
Writings and Projects of Kevin Lynch*
Edited by Tridib Banerjee and
Michael Southworth
MIT Press, \$50

BY MICHAEL HOLLERAN

WHEN Kevin Lynch began teaching in MIT's city planning department in 1948, the profession, like a second-generation immigrant, was distancing itself from its roots. Planners were moving away from landscape architecture and "City Beautiful" design, drawn instead to the vacuum of social policy, or to the institutional and economic workings of cities—anything but how they looked, or even how they



Kevin Lynch found that maps drawn by locals—in this case, sketches of an Argentine neighborhood by schoolchildren—are a useful gauge of how people perceive cities.

should be arranged on the ground. For most planners the physical environment was a mere byproduct of more interesting factors.

But for Lynch, who had studied with Frank Lloyd Wright, nothing could be more interesting than the tangible city as "a work of art, fitted to human purpose." So that people might better practice this art, he set out to systematize the whole field of knowledge of the physical form and making of cities. To an extraordinary degree, he succeeded.

Tridib Banerjee and Michael Southworth, two of Lynch's former students and collaborators, have collected scattered articles, unpublished papers, and excerpts from some of his many real-world projects into *City Sense and City Design*. The volume complements Lynch's eight books to wind up his published writings. The editors' thoroughness swelled *City Sense* to over 800 pages, but among the most enjoyable pieces are some of the ones for which they dug deepest, such as previously unpublished accounts of journeys through Italy, Poland, and China, which let us travel together with this most avid student of the city.

Kevin Lynch, who died in 1984, is still probably best known for his first little

book, *The Image of the City* (1961). Through clever informal survey methods—asking directions on the street, having residents draw maps—he explored cities through the eyes of their users, and he recommended that cities be designed with that view in mind. He talked about how the environment could be made "legible." In several *City Sense* essays he suggests that there is educational value in making it "transparent" as well. "Building construction," for example, "is fascinating because it is one of the few industrial processes left open to view." Lynch's concern for perception made him particularly interested in the design of streets and highways. "Roads," he wrote, "are the observation platforms of a city, the prime means by which people organize large regions, making them psychologically as well as physically accessible."

One of the pieces in *City Sense* is Lynch's reflections, shortly before his death, on *The Image of the City*. The book had stimulated research in the new field of cognitive geography and tempted psychologists out of the laboratory "into the light of day." But he was disappointed that planners and designers adopted his language as if it would predict the experience of place and save

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them the unpleasant business of actually talking to people. Imposing one's own order on the environment "is the pleasure that designers so enjoy—and so often deny to others."

For Lynch, design would be a widespread activity, inseparable from the continuing management of places, not a specialized role carried out by a professional priesthood. "Instead of demanding that 'one percent for art' be expended on works chosen by experts before a building is erected, let that sum be reserved for outdoor improvements one year after the building is occupied, as determined by the actual tenants."

During the 1970s and '80s, public attention did turn back to the physical city, under the banner of "urban design," but this large-scale architecture was not what Lynch had in mind. Urban designers' mantra was "contextualism," yet all too often they related to context simply by mining it for attractive surface details. Architectural training did not prepare them for considering the human context of neighbors and passers-by, and any effort they expended in this direction did not photograph well for architectural magazines.

"City design," in the book's title, is Lynch's answer to urban design. It is not architecture scaled up but a distinct art of shaping the large-scale environment in the service of its inhabitants. City design is emphatically an art—though a peculiar one, acting upon its medium only through intervening layers of abstraction such as law and administration. Lynch was concerned that few of our concepts for understanding and manipulating urban form are adequate to the new scale at which we build cities, and his biggest life's work was providing these concepts, creating for urban form a comprehensive "normative" theory. Functional theories, such as those of economics, transportation systems, or social ecology, explain the forces that influence urban growth and the processes that take place in a city; normative theory tells you how to make one.

In a work dealing largely with prac-

tical human affairs, it is extraordinary that few if any of *City Sense's* essays are yet period pieces; though some are nearly 40 years old, they do not rely for their sense on knowledge of their historical context. Lynch's earliest articles, analyzing theoretical future forms of settlement such as "polycentered nets" and "dispersed sheets," are more instructive than ever now that we live in the vast uncitlike urban regions he foresaw, with many centers and no center. Little of Lynch's writing is going to be dated any time soon. He picked big questions, the ones that are still with us.

Timelessness, however, can be a curse. Lynch thought about cities solely in order to make better ones, and his later essays sometimes show traces of frustration that his theories often inspired not action but more theory. His

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insistence that the city could be made to delight and inform placed him too often on the shelf with utopians. Yet Lynch was not naive. He was a perceptive observer of the environment as an expression—and enforcer—of social inequities, and of the play of power in shaping it, but he was too much an optimist to believe the city must merely map the social tensions it housed. He expressed impatience with utopias that failed to make a connection between their imagined futures and our present reality, even as he created imaginary worlds of his own. These the editors have brought together as the final section of *City Sense*.

Lynch's utopias do not depict some ultimate static perfection. Instead they are messy places where changes, migrations, even abandonments continue—yet in more satisfying ways, where "men are no longer an uncontrolled disease of nature." Some of Lynch's imaginary worlds are cacotopias, nightmare settings he found effective for making his points. "Hell is always vivid and convincing," he wrote. "Heaven, unfortunately, tends to be vaguely sweet, tenuous, and monochrome." The most vivid and convincing of all is "Coming Home," an account of Lynch's attempt to find his house outside Boston after the city has been leveled by nuclear attack.

If anything seems dated about Lynch, it is, alas, his optimism. We contemplate spending trillions of dollars to rebuild our entire transportation system, yet we are far from embracing Lynch's idea that this money ought to buy travel that is in itself pleasurable. Our national debate over education focuses ever more narrowly inside the classroom, ignoring his observation that the whole environment helps us learn, and might be made to do the job better. "However misshapen," wrote Lynch in one of his last essays, "a city is an *intended* landscape." Are our intentions good? ■

MICHAEL HOLLERAN is a professor of urban and regional planning at the University of Colorado, Denver.

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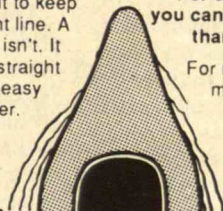
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"It is remarkable that Bat-PA, along with proteins and peptides from leeches, snakes, and insects . . . may come to assume major importance in cardiovascular drug development," notes Nils Bang in an editorial in *Circulation*, the journal of the American Heart Association.

Medical Computers

An Institute of Medicine committee has called for health care professionals to adopt computer-based patient records as the standard for use in research, education, administration, policymaking, and patient care.

New Yorkers can bank in California on an automated teller machine, but if they get sick, California hospitals have no easy access to their medical records. "It's no longer a question of *whether* we should move to computer-based patient records; it's a question of *how*," notes committee chair Don Detmer.

Fetal Tissue Debate

The Association of Biotechnology Companies (ABC) is supporting a congressional move to lift a federal ban on fetal tissue research. "The existing limitations . . . directly impede progress in developing new cancer therapies," says the association. "Very promising therapeutic applications for transplanted human fetal tissue also exist in the fight against Alzheimer's and Parkinson's diseases."

With the support of abortion opponents, the National Institutes of Health has maintained the ban against the advice of its own study panel. Lifting the ban, says ABC, would help remove "current political impediments on important medical research."

Global Truth

Schools in several states are testing an innovative environmental program that has students collect local information, share their findings with peers worldwide, and compare the results to data from earth-observing satellites. Designed by the Aspen Global Change Institute, the Ground Truth Studies Project engages young people in the International Space Year's Mission to Planet Earth.

For example, one of the 19 exercises has youngsters match recent satellite photos of their region with those taken a decade or so ago and assess the changes. The students then go outdoors to learn how the images from space relate to what they see around them.

Nuclear Rockets

According to the Federation of American Scientists (FAS), the Pentagon is conducting secret studies of nuclear-powered rockets and "evaluating the

use of nuclear rockets in future offensive strategic missiles." The intention is to provide "improved payload delivery capability," even though today's missiles could easily handle all the warheads existing treaties allow.

"One eccentric Pentagon source," says the FAS, "asserts that nuclear rockets would offer an environmental benefit over current ICBMs because they would use less of the conventional solid propellants which, it has been argued, cause damage to the earth's ozone layer."

Science & the Press

Using acid rain as a case study, Wilfred Lancaster of the University of Illinois and Szarina Abdullah of Malaysia's Mara Institute of Technology have found that scientists who write for general audiences are usually the same ones called to testify in Congress.

The witnesses are cited more often in professional publications as well, suggesting that "scientists called before congressional hearings are among the most influential within the science community," says Lancaster. The study, which appears in *Scientometrics*, also found that under 5 percent of acid-rain researchers have written for the popular press.



Dinosaur Death

NASA researchers have recently reported evidence of a crater formed by a comet or asteroid that may have killed off dinosaurs and other species about 65 million years ago. Some scientists believe such an impact pushed enough dust and debris into the atmosphere to block sunlight, interrupt plant growth, starve animals, and freeze much of the earth.

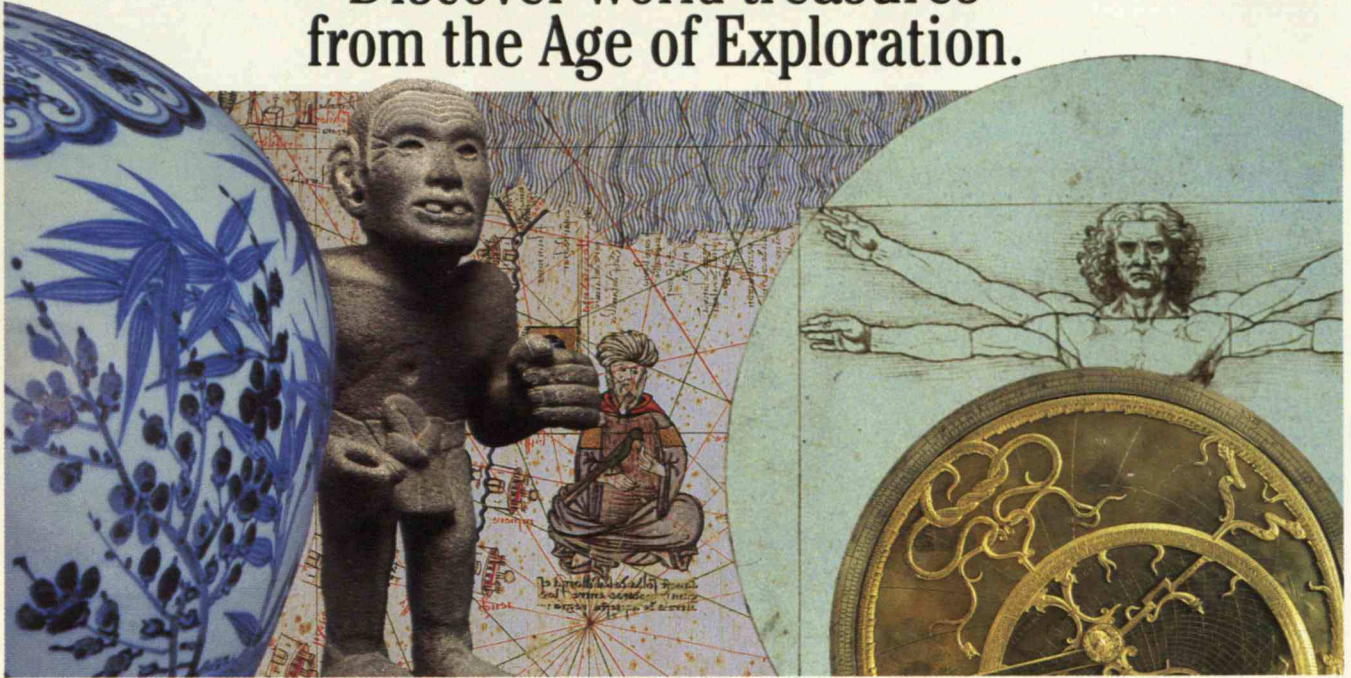
More than 125 miles in diameter, the crater is a buried ring of sink holes in the Mexican Yucatan. Charles Duller of NASA's Ames Research Center discovered the formation four years ago while searching satellite images for the water sources of ancient Mayan cities.

Chernobyl Lottery

Soyuzekologiya (Union of Ecology), a Soviet environmental group, is raising funds to deal with the aftermath of Chernobyl by selling lottery tickets in Japan, Norway, and the United States. The money will support studies of genetic changes, provide legal and medical aid, and help relocate refugees.

According to *Earth Island Journal*, awards include 10 cars, donated by Volvo. Also, the New York City Ballet has promised to give 10 charity performances. Lottery organizers hope to raise some \$150 million.

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National Gallery of Art

Washington, D.C.

October 12, 1991-January 12, 1992

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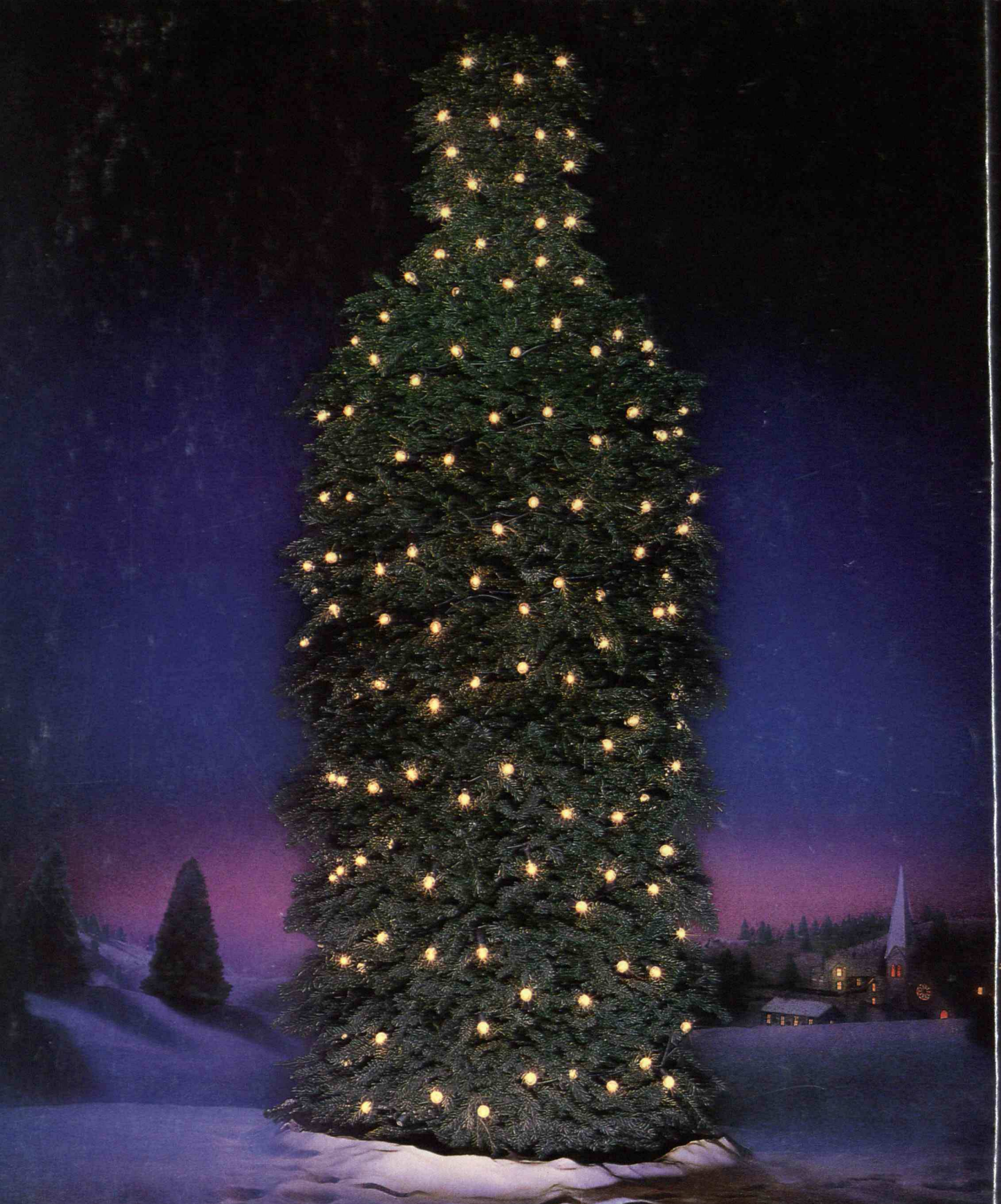
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